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IN PLANTS, MILLS, AND FACTORIES

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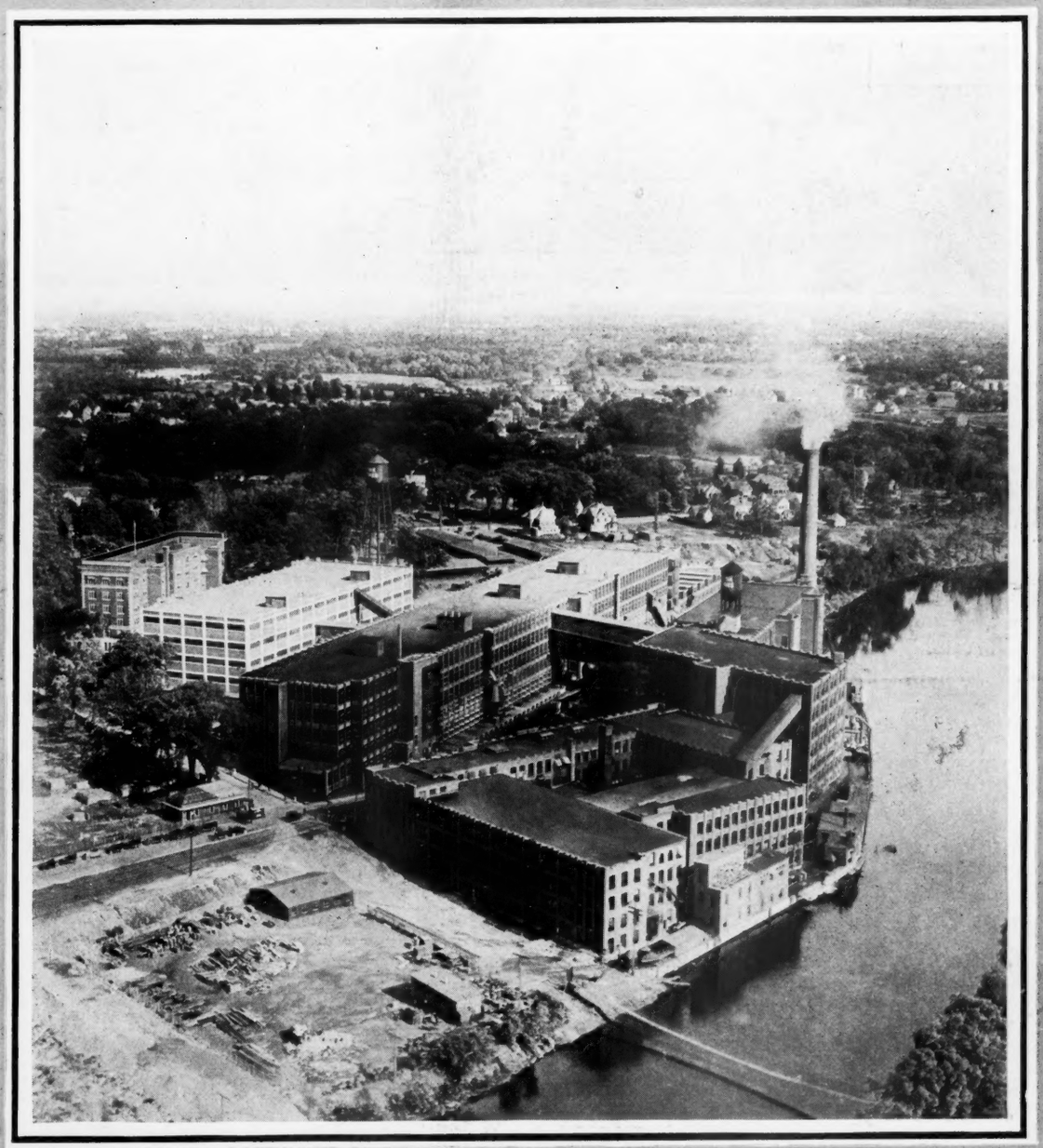

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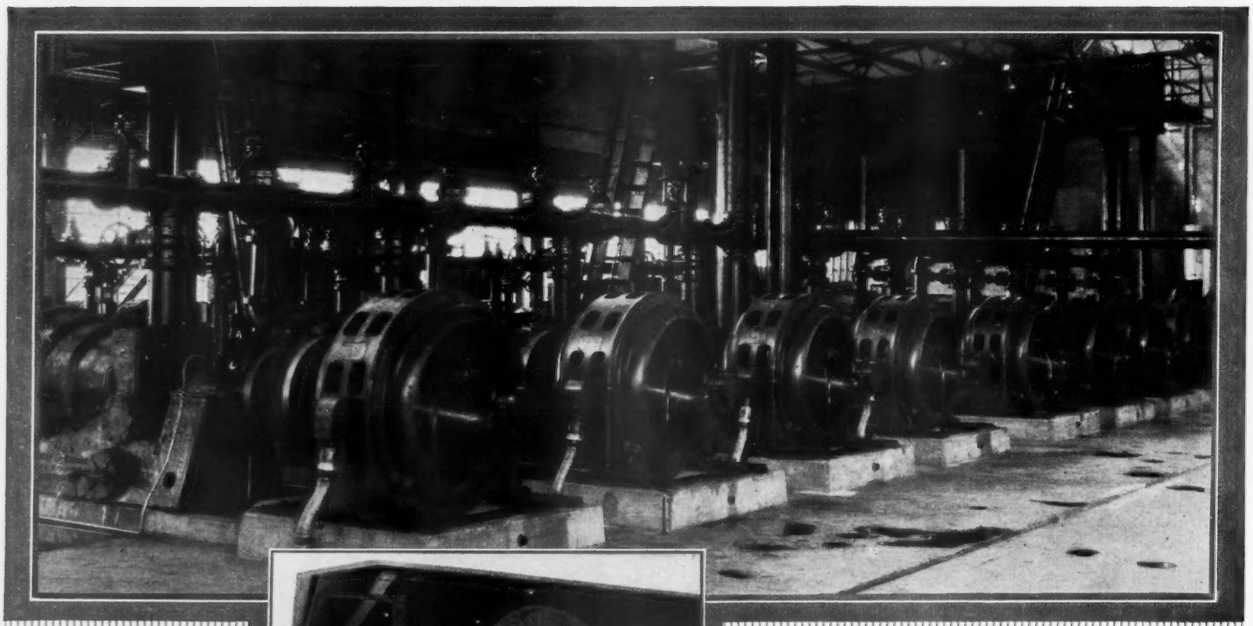
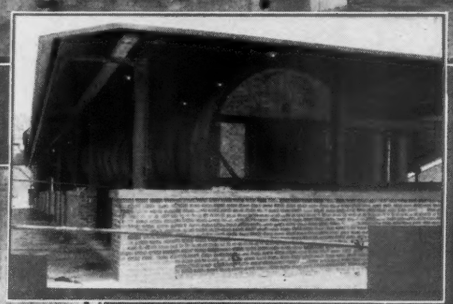
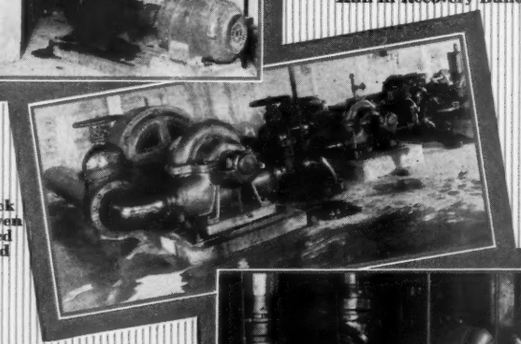


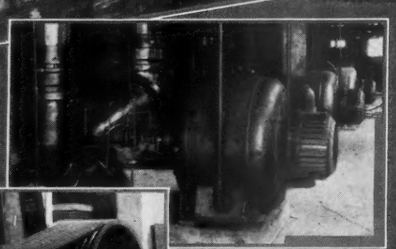
450 h.p. Synchronous Motors driving Jordans.



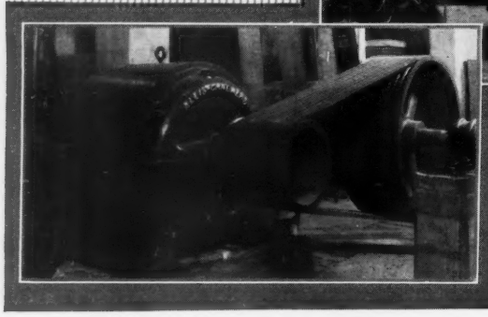
10′x 135′ Allis-Chalmers Lime Kiln in Recovery Building.



Allis-Chalmers Paper Stock Pump driven by Enclosed Fan-Cooled Motor.



Pump Room with Allis-Chalmers Motor-driven Pumping Units.



Enclosed Fan-cooled Synchronous Motors driving Liquor Pumps.

Two Winding Slip-ring Motor and Texrope Drive, operating winder.

15000 Horse Power of Allis-Chalmers Motors in Southern Kraft Mill

Allis-Chalmers motors are used throughout the new Panama City Mill and many of the applications are new and unique. A special feature is the large number of totally enclosed fan-cooled motors, extending even to the use of slip-ring and synchronous types.

Every motor in the digester building is of the enclosed type, first because of corrosive gases and secondly, because of the water hazard due to the washing of equipment.

The barking drums are driven by special synchronous motors. The winder drive consists of a two-winding slip-ring motor and simplified control instead of the complicated D.C. system usually employed.

Allis-Chalmers also furnished eighteen improved paper stock pumps, thirty high efficiency double suction pumps, and a fire pump, all but the latter being motor driven. Texrope Drives total well over a thousand horsepower. A 10′x 135′ Allis-Chalmers lime kiln is used in the Recovery Building.

Allis-Chalmers has furnished equipment for practically every southern mill, producing kraft and with this experience is in a position to make recommendations and furnish equipment suited to this class of service, not only from a theoretical, but also a practical standpoint. Our nearest district office will be glad to co-operate with you in improving your operating conditions.

ALLIS-CHALMERS

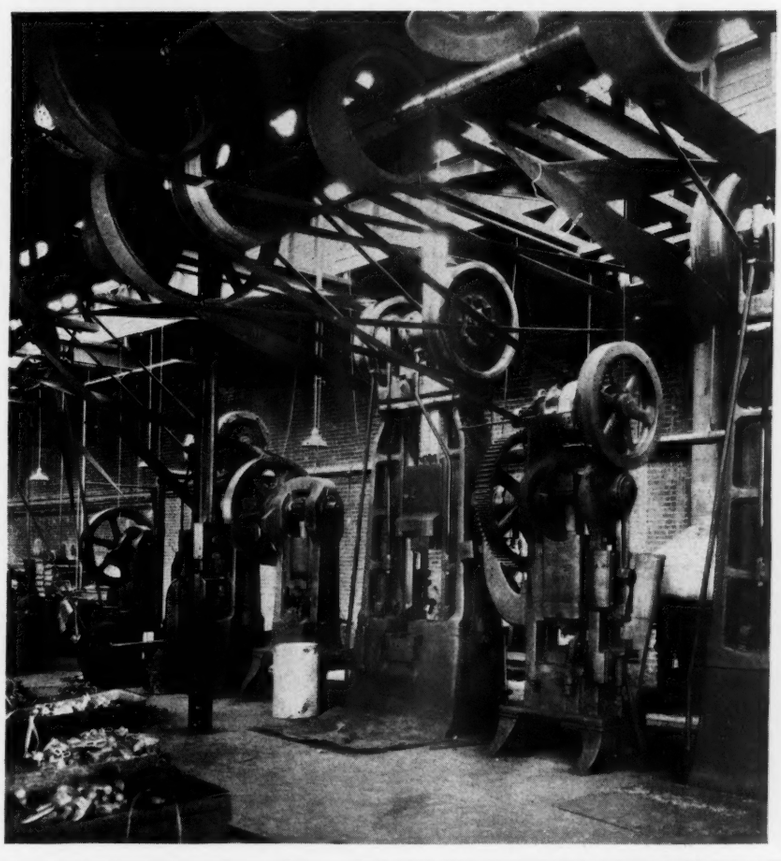
Allis-Chalmers Manufacturing Company, Milwaukee

MAINTENANCE ENGINEERING

A McGraw-Hill Publication, founded 1882

AUGUST, 1931

POWER TRANSMISSION POINTERS



Mounting lineshaft hangers on a solid footing and keeping the shafts properly aligned will eliminate the greatest source of trouble with mechanical power transmission equipment.

C. E. BAILEY

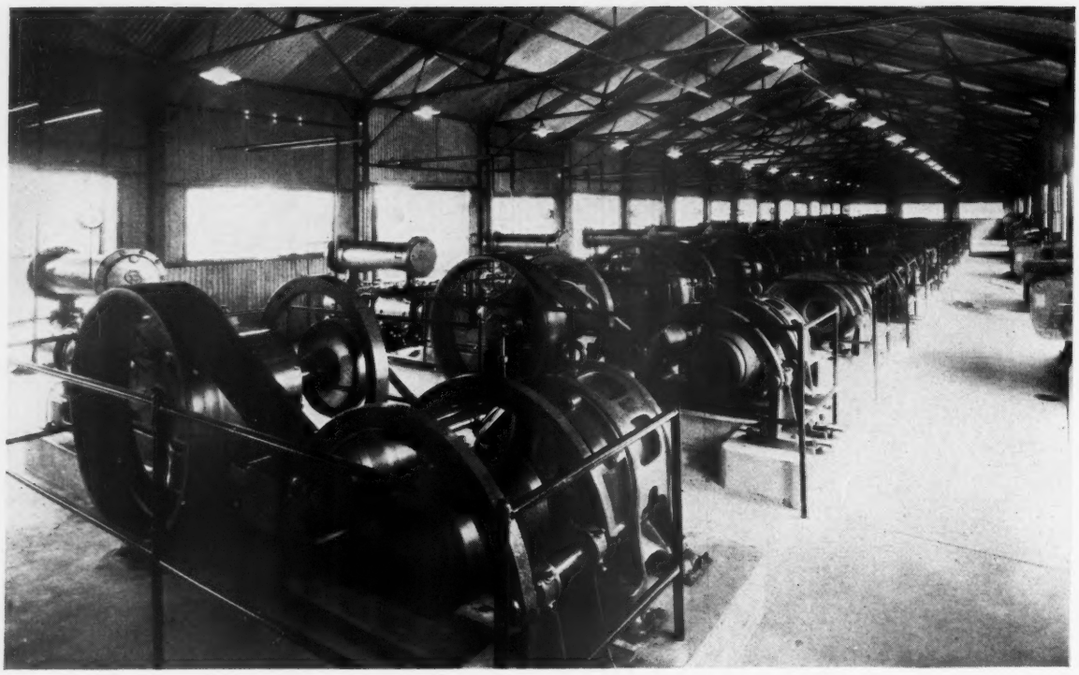
Sales Engineer
T. B. Wood's Sons Company
Chambersburg, Pa.

SELDOM is the same thought and attention given to the selection and installation of the machinery for transmitting power that is given to the source of power and the machines receiving power therefrom. A major fault in the selection of power transmission machinery is false economy in first cost, by rating the capacity of a drive for the present needs, and subsequently working it beyond the limit of its endurance. Initial cost is of minor importance where uninterrupted and satisfactory service is required.

In this article some mistakes that frequently occur in selecting and installing transmission machinery will be pointed out, with suggestions for preventing them.

SHAFTING

Headshafts are often selected simply for their horsepower capacity, without considering the heavy head pulleys and clutches they carry, with the result that excessive deflection oc-



The idler pulley on short-center drives should be placed close to the smaller (usually the driving) pulley, so as to increase the arc of contact of the belt.

curs, and results in breakage of the shaft.

When a shaft in a grain elevator broke investigation showed that drives had been taken off the line until the load exceeded the capacity of the shaft. A larger shaft was necessary, but to avoid replacing bearings, pulleys and clutches, a chrome-nickel, 40-carbon-steel shaft was used. The use of alloy steel did not reduce deflection, but the higher tensile strength has enabled the shaft to carry the extra load for several years.

Dust or lint frequently is allowed to accumulate on lineshafts. Such accumulation close to a bearing will act as a wick, and by capillary attraction drain the oil out of the bearings. A floating ring of leather, fibre, or heavy cardboard will travel the unobstructed length of a shaft and keep it clean.

Without doubt, the greatest source of trouble in transmission machinery is misalignment of shafts, either coupled shafts or two or more supposedly parallel lines. Many bearing and clutch failures and considerable belt trouble may be traced to this cause. Shafting should be straightened after having keyseats cut in it, as the removal of the metal tends to bend the shaft. It is well to specify this operation when ordering shafting, as not all transmission dealers have shaft-straightening equipment.

New installations are often designed for shafting in fractional diameters of halves, quarters or eighths. Commercial ground shafting is manufactured in sizes varying by sixteenths, and transmission machinery is stocked in these sizes. Standard diameters are $\frac{15}{16}$ to $3\frac{15}{16}$ in., varying by quarter inches, and from $4\frac{7}{16}$ in., varying by half inches. By selecting standard sizes, deliveries and replacements may be greatly expedited.

Bearings

Babbitt used in ordinary commercial bearings is not suitable for heavy loads of long duration, nor for shock loads, and should not be used for loads in excess of 150 lb. pressure per square inch of projected area.

Bearings have been condemned after a few weeks' use, with the babbitt rolled up or melted out. Investigation has always shown either excessive load or speed for the type of bearing selected, dust syphoning the oil from the bearing, or misalignment of shafts; the latter is the most common cause of failure.

Ring-, chain-, and collar-oiling bearings must have the oil reservoirs filled while the shaft is standing idle. These bearings hold considerable oil in suspension, and if they are filled while the shaft is revolving the oil will overflow when the shaft stops.

Frequent sources of trouble are the selection of plain, grease-lubricated bearings for high speeds, and neglect to lubricate them with the frequency that is demanded.

For shafting speeds of 100 f.p.m. and over, self-oiling bearings should be used, either ring- or collar-oiling, depending on the kind and severity of the load.

Ball bearings are in such general use that a word of warning against abusing them, especially in loose pulleys, may be in order. It is customary to ship loose pulleys with the ball bearings mounted in place, as they can be better protected in this way than when mounted in the field. With all this care in wrapping, and with a caution tag attached regarding the careful handling necessary, I have seen ball-bearing pulleys with the wrapping removed and the pulley hub buried in mud. The bearings had to be removed and thoroughly cleaned, as a very small particle of dirt can ruin a ball bearing.

Couplings

Plate or flange couplings should be pressed on and the faces machined while in place on the shafts. If it is necessary to use solid pulleys, a coupling should be pulled off one end to permit mounting them.

All types of compression couplings require some attention and care at first. After they have run for a short time they should be inspected and, if necessary, the bolts should be taken up. This procedure should be repeat-

ed at short intervals, especially on lines subjected to shock or heavy loads.

Flexible couplings cannot be used as universal joints. Units driven with flexible couplings must be aligned as accurately as possible, both laterally and angularly, as the couplings usually will compensate for only slight misalignment.

Clutches

There is no limit to the mistakes that can occur in selecting and installing friction clutches. The principal causes of failure are: Underrating the power requirements, undue slippage in starting at high speeds, adjusting the friction surfaces with unequal pressure, and misalignment of shafts in a cut-off coupling.

The speed of the driving element at the mean diameter should not exceed 3,800 f.p.m Where high speeds are necessary, multiple-disk clutches should be used.

The same general rules that apply to bearings also apply to clutches. For high speeds the sleeve carrying the pulley should be mounted on ball bearings. For moderate speeds self-lubricating bronze bushings should be used, or if the idle period of the sleeve is of short duration, a plain cast-iron sleeve may be used without bushings.

Ball bearings should be used when a clutch is mounted on a lineshaft that rotates constantly, while the pulley stands idle for long intervals. This condition would cause a bushing to wear in one place where it rests on the revolving shaft.

Clutches that are required to slip for a short time, to pick up a load, should have the disks faced with a non-burnable material, especially if operating at high speeds.

Clutches should be selected with generous — even prodigal — over-capacity. Manufacturers are compelled to list their clutches on a competitive basis. The power rating is only for normal load conditions. Where shock loads are encountered, or the clutch is operated with unusual frequency, a larger clutch should be selected.

Clutch couplings of the disk type, with disks keyed to the cover, show a tendency to grind off the sides of the key. This action is due to misalignment of the shafts that are coupled by the clutch; hence the remedy is obvious.

The impossibility of using a flexible coupling as a universal joint has been mentioned; it is just as impossible to use a cut-off clutch as a flexible coupling.

Pulleys

There is an economy in using heavy, cast-iron pulleys that will usually repay the extra cost. A number of heavy pulleys, with increased WR^2, will smooth out load impulses in a lineshaft, which otherwise would be transmitted to the belts and bearings, as well as to the work.

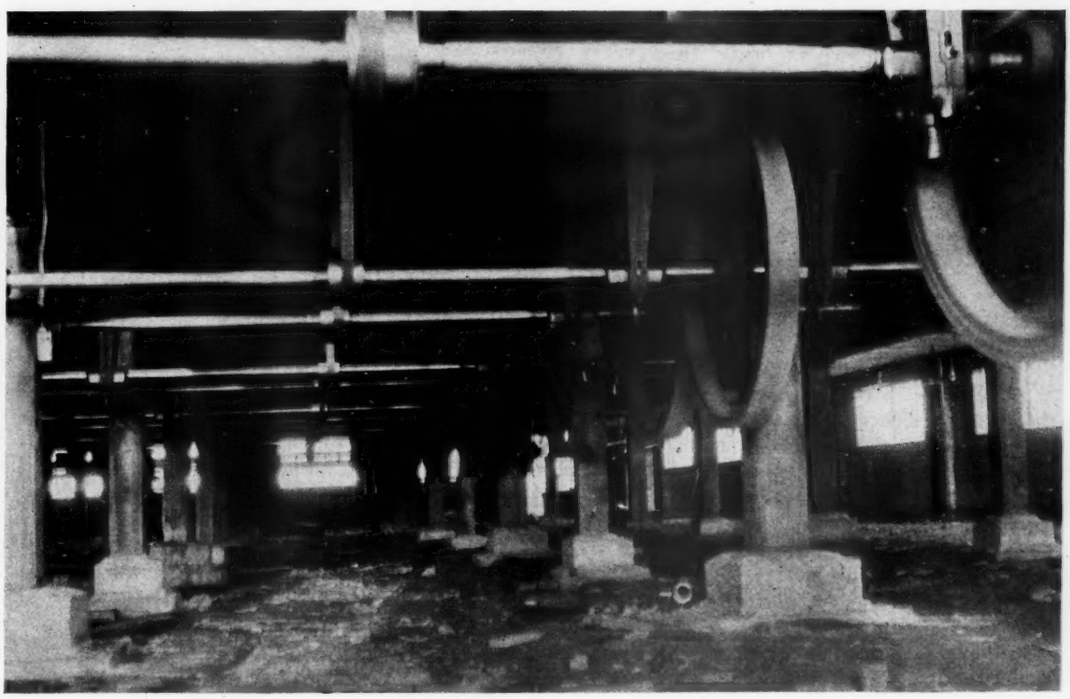
In textile mills, the lineshafting for loom drives is equipped with a balance wheel on the end of the line opposite the drive. Standard wheels with weights of 150, 200, 250 lb., have been adopted for these lines. The same effect would be produced by using heavy pulleys all along the line, and would give the added advantage of distributing the weight over more shafting.

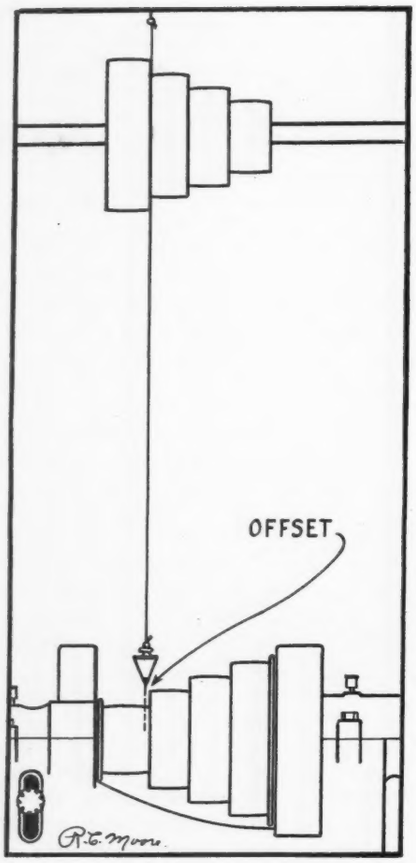
Wide-face pulleys, or pulleys running in excess of 300 r.p.m., should be dynamically balanced. When a number of pulleys are to be installed on a lineshaft, it is well to have them all dynamically balanced; otherwise the value of the flywheel effect of the heavy pulleys may be counteracted, and each pulley give an impulse of its own to the line.

A cast-iron pulley is often regarded as just so much cast iron, and handled accordingly. Pulleys often are abused before installing, being rolled from place to place, sometimes down a step or two. These shocks will eventually make apparent the initial strains in the casting. Steel pulleys mishandled in this way may not break, but a worse condition occurs; they become bent, and very often are run in this condition to the detriment of belts and bearings.

Split, cast-iron pulleys have ragged

Flywheels are frequently used on lineshafts for loom drives in textile mills to smooth out load peaks.





When installing step pulleys, belt wear can be lessened by offsetting the upper and lower pulleys approximately ½ in., as shown here.

surfaces at the fracture, and these interstices on each half of the joint mesh together. Care should be exercised in handling, for if any part of these fractures receives a bruise the fracture will not mesh. This prevents the pulley halves from joining properly, so that the pulley will run crooked and will not fit the shaft.

Many delays are caused by insufficient information on an order for a pulley. Specifications should indicate whether solid or split construction is desired, straight or crowned face, diameter, face, bore, and keyseat. When the width of the pulley is specified, the belt width should also be given, as pulley faces are always wider than the belts they carry.

The power and speed should also be specified, as the speed often affects the design. Split pulleys running in excess of 4,000 f.p.m. should be split through the arms, and over 4,500 f.p.m. should have return or inside flanges at each edge of the rim.

It has become general practice to insure pulleys that run in excess of 5,000 f.p.m. This is advisable, as manufacturers will not guarantee pulleys at high speeds, especially when of split construction. It is apparently not generally known that in mule pulley drives, where the angularity of the two shafts is less than 90 deg., the mule pulley carrying the slack strand of the belt should have a face width 3 to 4 in. more than the belt width, as the crown of the mule pulley, no matter how high, will not hold the belt in line when slack develops in starting the drive. This is due to the small arc of belt contact with the mule pulleys.

Belts

In planning a drive between two rotating members the first step is to decide the best means for transmitting power, taking into consideration the amount and nature of the load, and the speed.

If positive speeds must be maintained, it will be necessary to use chains or gears as the transmitting medium. If the load is subject to shocks, or the starting load is heavy, the drive must be selected with a generous factor of safety.

Belt drives, although not giving positive speeds, have a flexibility and elasticity that absorb shocks. Under abnormal loads the belt will slip on the pulley and protect the other equipment.

In planning belt drives, it is advisable to keep the diameters of the pulleys as large as possible, so as to get belt speeds of 3,000 to 4,000 f.p.m., and permit the use of narrower belts.

Multiple V-belt drives have attained unusual popularity in the past few years. This type of drive is practicable for speed ratios as great as 7 to 1, but must be installed with means of adjusting the center distance, or with an adjustable idler.

Flexible Idlers or Belt Contactors

Flat belt drives may be made almost positive, and still retain the flexibility inherent in belt drives, by the application of a belt contactor to increase the arc of contact of the belt with the smaller pulley.

Drives of this type are used successfully on short centers with ratios limited only by the permissible diameter of the large pulley. They are also used to advantage on long-center drives when the power requirements have been increased beyond the capacity of the existing drive.

The usual fault with short-center belt drives is the improper location of the fulcrum. It should be on a line drawn through the centers of the driving and driven pulleys, so that the idler pulley will describe an equal arc about the small pulley. The idler pulley must be on the slack side of the belt and adjacent to the small pulley.

It is necessary to use a good, pliable belt for a short-center drive. The added bend in the belt under less tension is less harmful than the increased tension required in an open-belt drive, and will put less load on the bearings.

There is available on the market a short-center flat-belt drive in which constant tension is maintained on the belt under all loads, without the use of an idler. This action is accomplished by mounting the motor on a special base that is pivoted at one end, so that the weight of the motor serves to maintain the desired tension on the belt.

Drives that produce a whipping motion to the belt indicate lack of sufficient flywheel energy to carry over impulse loads. This belt whip cannot be overcome with either a tightener or a contactor, and can be remedied only by a heavier flywheel. Installing a tightener midway between the pulleys would decrease the amount of belt whip only by decreasing the span of the belt.

■

Accidents in 1930

NINETY-NINE thousand persons were killed in accidents in 1930; and there were 10,000,000 nonfatal injuries. These accidents cost the American public $3,250,000,000.

Between the ages of 5 and 14, accidents cause more than twice as many deaths as the most important disease.

The death rate from accidents in the United States is twice as high as in the principal European countries and 30 per cent above Canada and Australia.

Among males, accidents are the second most important cause of death, being exceeded only by heart disease. Tuberculosis causes only two-thirds as many deaths as accidents.

The motor vehicle is now the most serious accident hazard; 33,000 persons were killed in 1930. Home accidents were almost as important, killing 30,000. Industry accounted for only 19,000 deaths, and 3,000 of these involved motor vehicles.

These figures were compiled by The Statistical Bureau, National Safety Council.

Distributing the Electrical Energy

R. G. HORNBERGER
Electrical Engineer

DISTRIBUTION of electrical power is one of the most important factors in the economical operation of any industrial plant. Although this essential service is little understood by many men responsible for the design and operation of plants, the fundamentals of the design of a distribution system are simple. It is the purpose of this and a succeeding article to give a general picture of the planning of such a system. Complete design data cannot be presented here, but references will be given to sources of further information concerning details of design. Fig. 1 illustrates several of the distribution schemes discussed.

Assume that power is to be purchased from an outside source. The power will probably be received at a high voltage—2,300 volts or more. A substation, furnished by the customer, will be required for stepping down the voltage and distributing the power to the various feeders. If power is purchased at a low voltage the substation will be furnished by the power company. If there is a choice, the cost of power delivered at a low voltage must be balanced against the cost of power at a high voltage, plus the cost of interest, depreciation and maintenance on the substation, and cost of power lost in the transformers.

With small power loads it is not economical to use more than one incoming line, but it is always desirable to have some reserve line capacity. For larger loads, the incoming line capacity should be large enough so that all the essential load can be carried when one line is out, with only a reasonable overload on the remain-

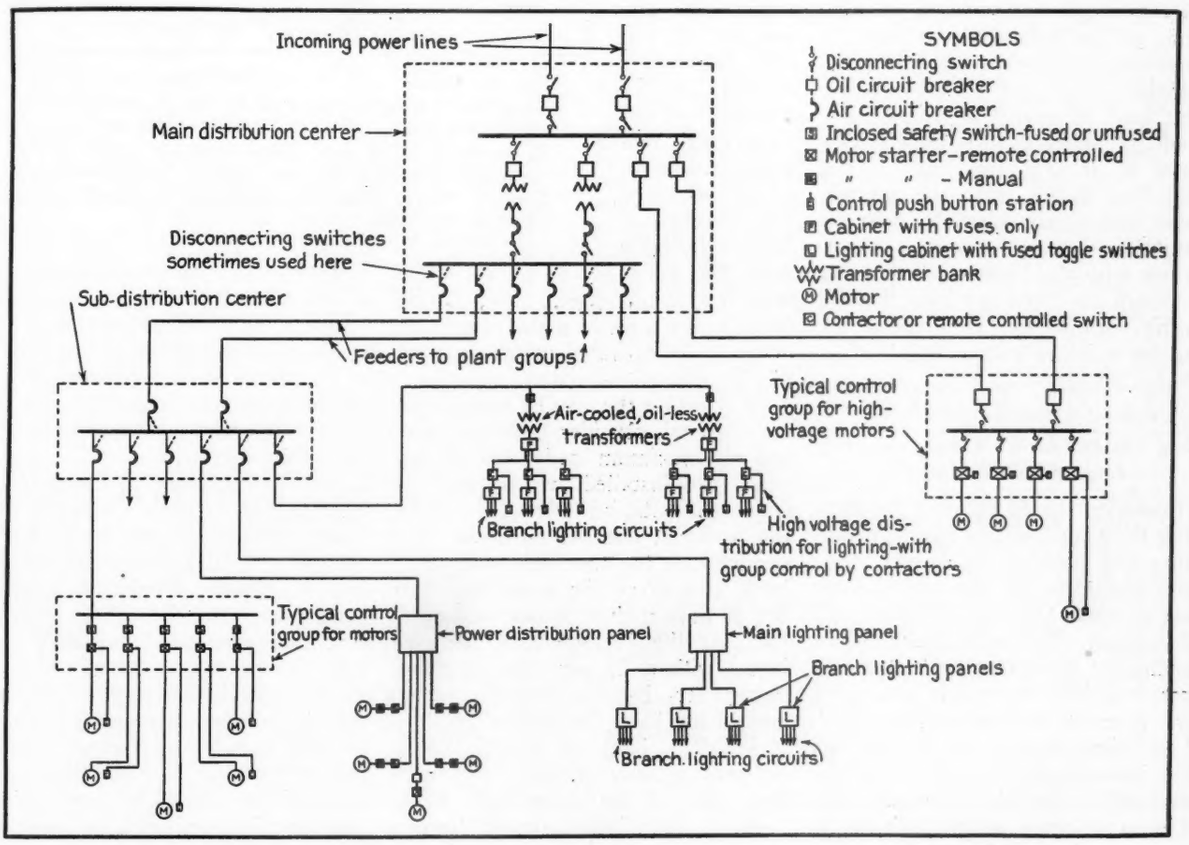


Fig. 1—Typical schemes employed in distributing electrical energy in industrial plants.

ing lines. Items found in a fully equipped substation are: Transformers, circuit breakers, disconnecting switches, bus structure, and provision for metering equipment. If the lines are brought in overhead, lightning arresters, with disconnects, will have to be provided. Metering equipment will be provided by the power company.

Transformers may be either single- or three-phase, oil- or air-insulated, self- or water-cooled, and indoor, outdoor, or subway type. Three-phase transformers require a lower initial investment, but cause a greater loss in case of breakdown. Therefore, for small and medium-sized installations, single-phase transformers are preferable. Nearly all transformers of any appreciable size are oil-insulated.

Water-cooled transformers may be used where it is essential to keep the initial investment down, or where the water supply is cheap and reliable. Otherwise, the self-cooled type is preferable. Where extreme moisture or thick deposits of conducting dust are present, it is desirable to bring the leads to the transformer in lead-covered cable, in which case the subway type with sleeves for wiped joints and inclosed bushings should be used.

In selecting a transformer, the shape of its efficiency curve should be considered. If the core losses are low and the copper losses high, its efficiency will be highest at part load. If the reverse is true, its efficiency will be highest at or over full load. If the plant load is steady, a transformer should be selected with highest efficiency at or near full load; if the plant load varies, with the average power demand considerably under the maximum demand, select a transformer with the highest efficiency at part load. In evaluating bids, the following formula can be used, if the load curve is known:

$$\textit{All-day efficiency} = \frac{\textit{Total Output for 24 Hours}}{\textit{Total Output for 24 Hours} + \textit{Total Losses for 24 Hours.}}$$

Provision should be made for handling the transformers during installation and removal for repairs. The tanks should be set on rails of some kind to make the use of rollers and skids easier. For large banks, where moving by rollers is expensive and slow, it is best to provide a transfer car. A crane or hoist of some kind, of sufficient capacity to lift out the core, is necessary if repairs are to be attempted on the job. This crane must be in an inclosure, as no work can be done outdoors if the weather is the least bit damp, but the crane should not travel over the transformers because of the danger of the hook getting into the leads.

Four possible transformer connections may be used: delta-delta, delta-Y, Y-Y, and Y-delta. The Y-Y connection can be eliminated because, with transformers of the usual construction, it allows triple harmonic voltages to form between the lines and the neutral. The chief advantage of the delta-Y or Y-delta connections is the possibility of grounding the neutral, thus reducing voltage strains. The advantage of the delta-delta connection is the possibility of operating two transformers in an open-delta or V-connection. This is desirable when the plant is fed by only one bank of transformers, for if one transformer burns out the remaining two may be operated at 58 per cent of the original capacity.

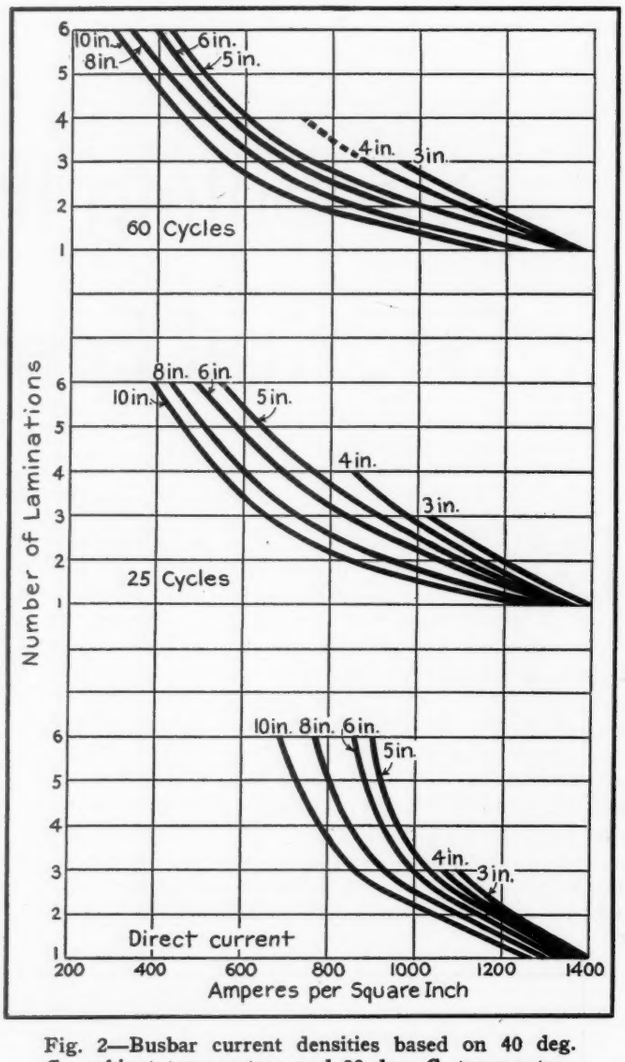


Fig. 2—Busbar current densities based on 40 deg. C. ambient temperature and 30 deg. C. temperature rise. Bars are assumed to be ¼ in. thick and spaced ¼ in. apart. The data given here can be used for loads up to about 4,000 amp., and are taken from the Electric Power Club Handbook of Standards, 16th edition, page 195.

In selecting the size of transformers required, consider both the average and maximum loads. Where two banks are installed, or one bank is connected delta, it is advisable to have the banks at least of such size that one bank, or the open-delta-connected bank, can carry the maximum load for 30 min. with a 50 per cent overload, or the average load for two hours with a 25 per cent overload. Remember that the capacity of an open-delta bank in parallel with a closed-delta bank of similar transformers is only 26 per cent more than that of the closed-delta bank.

Every installation should have a main or service switch for the control of the main incoming line or lines. For small low-voltage systems, it may be an air circuit breaker, but usually an oil circuit breaker is used. In addition to the voltage and current rating, the interrupting capacity is very important.

If it is necessary to compute the interrupting capacity required, the following assumptions should be remembered: In any normal a.c. circuit containing apparatus such as generators, transformers, reactors, etc., the reactance is much greater than the resistance; hence the resistance is usually neglected entirely and the short-circuit current is assumed to be at zero power factor. Computations can then be made directly on the basis of Ohm's law, except that reactance is substituted for resistance

when applying the formula, so that

$$I = \frac{E}{R} \text{ becomes } I = \frac{E}{X}$$

Controls for the service switch or switches comprise an operating mechanism and operating relays. The switch may be closed either manually, by solenoid, or by motor. It may be tripped, or opened, either manually, by a shunt trip operated by relays, or by a series trip. Where low cost is vital or the switch is infrequently operated, manual closing is usually adopted. In that case, it is desirable to have the breaker "trip free"; that is, so constructed that if it is closed on a short circuit, the operating mechanism will trip free from the handle as soon as the contacts touch and an excessive current begins to flow.

If the switch will be operated frequently, or if it is desired to control it from a remote point, either solenoid or motor operation may be used. Solenoid operation is the standard method, but requires a storage battery, usually of at least 125 volts. Where a separately energized source of low-voltage alternating current is available the switch may be closed by a small motor, wound for operation on either 110- or 220-volt circuits.

Relays for controlling circuit breakers are usually of either the plunger or the induction types. The plunger type is simple and reliable if properly maintained. The induction-type relay operates on the same general principle as the watt-hour meter.

Time-delay relays, of one of the two above types, are coming into wider use, because even severe overloads of short duration do little harm. On the other hand, a prolonged overload, even if slight, is dangerous. In cases where interruptions are serious, reclosing relays may be used, which reclose the tripped breakers after a definite time interval.

Provision must be made for the installation of the power company's metering equipment. This will consist essentially of current and potential transformers, a space (cabinet or panel) on which the meters can be mounted, and conduits from the meter cabinet to the instrument transformers in which the power company can pull the meter wires. For a delta system only two each of the current and potential transformers will be used, but for most Y-connected systems three each will be required. The meters usually consist of a watt-hour meter and either a printing or curve-drawing demand meter. If there is a power factor clause in the contract, a reactive-kva. meter is installed to give an average power factor.

Whenever transformers or other electrical apparatus of any appreciable size are inclosed in a vault or room, provision must be made for ventilation. The computations are simple. Multiplying the rating of the machine by 1.00 minus the efficiency (expressed as a decimal) gives the losses in kilowatts. In a 500-kva. transformer with an efficiency of 98.5 per cent the losses are $500 \times (1.00 - 0.985) = 7.5$ kw. As 1 kw. is equal to 3,415 B.t.u. per hour, the heat thrown off will be $7.5 \times 3{,}415 = 25{,}600$ B.t.u. per hour. As an average value, 1 cu. ft. of air will be raised 55 deg. F. in absorbing 1 B.t.u. Therefore, the amount of air necessary to keep the temperature from rising above a certain value can readily be computed.

In rooms where an operator is present it is desirable to keep the temperature rise down to about 15 deg. F. giving a room temperature of 100 deg. when the outside air is 85 deg. F. Where no operator is present, a rise of at least 20 deg. F. can usually be permitted. If the vault or room can be left open, with plenty of window area, no forced ventilation will be required, but if it is closed it will be necessary to install fans, which should be controlled by a thermostat to keep them from operating when the weather is cold.

In designing busbars, the principal factors are current-carrying capacity and ability to withstand mechanical stresses. Due to comparatively short runs, the voltage drop seldom need be considered, but the temperature rise is important. Due to crowding or proximity and skin effect of heavy currents in large conductors, resulting in an uneven distribution of the current in the conductor, the ratio of amperes per square inch is highly variable. From the curves in Fig. 2 the permissible currents for different sizes and numbers of busbars, for a rise of 30 deg. C., can be obtained.

Busbars could be operated at a much higher temperature than 30 deg. C., but there is a great danger of transmitting the heat to the connected apparatus, with resulting damage. Therefore, busbars are usually designed so as not to exceed the above temperature rise. The chart can safely be used for currents up to about 4,000 amp. For higher values special study will be necessary. In general, for large currents it is desirable to arrange the bars in each leg in the form of a modified square, but with all bars placed vertically.

When heavy currents, particularly short-circuit currents, are flowing, severe stresses are set up in the buses, due to the magnetic action, and they must be designed to resist these stresses.*

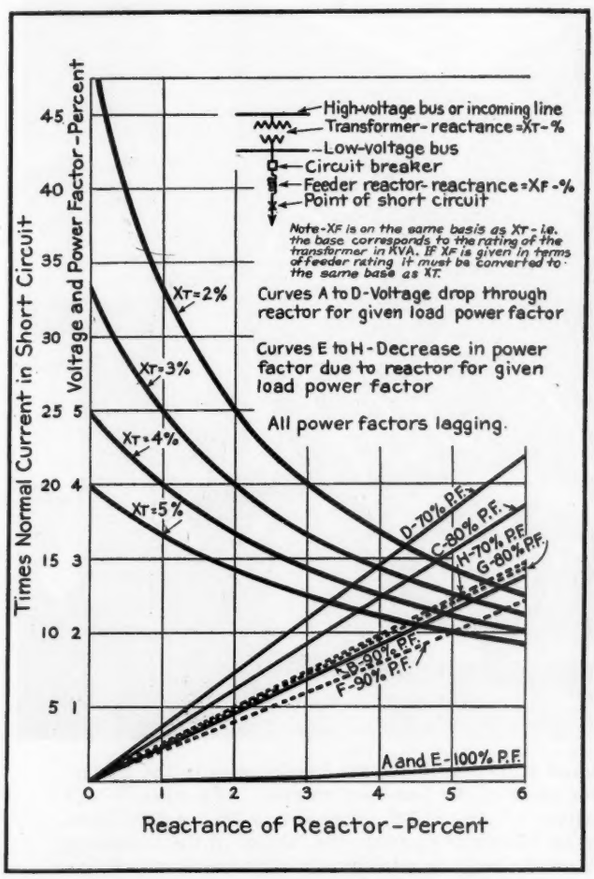


Fig. 3—Effect of feeder reactors in reducing short-circuit current and interrupting capacity required by the circuit breakers.

*Short Cut Methods of Calculating Stresses in Bus Structures, by W. Specht, August 1928, *General Electric Review;* and Current-Carrying Capacity of Busbars, by H. W. Papst, September 21, 1929, *Electrical World.*

Every industrial plan requires a main distribution center, which will consist essentially of a bus to which are connected switches for the feeders, with a switchboard or equivalent means for controlling the switches and indicating the amount of energy taken by each unit.

Fused knife switches, or air or oil circuit breakers may be used. Knife switches and air circuit breakers can be used only up to 600 volts, although recently, considerable development work has been done on the application of air circuit breakers to voltages as high as 15,000 volts. Knife switches should not be used (except simply as disconnect devices, not to be opened under load) on circuits carrying more than 200 amp., and even at that rating there is some danger attached to their operation. Above that rating, either air or oil circuit breakers should be used.

These switches may be operated manually or by solenoid or motor. The majority of installations are manually operated, although for large and important jobs the solenoid and motor mechanisms are used. Relays also are included among the types discussed above. Although plunger-type relays are usually used, the induction relay, with its accurate timing, selectivity and inverse-time characteristic, is well worth the extra investment for all important feeders in the plant.

As discussed under service switches, circuit breakers are rated according to voltage, current-carrying capacity, and interrupting capacity. As the parts of a circuit breaker can store only a very small amount of heat, their rated current is the maximum current they can carry continuously. Overloads can be carried for only a short time. Therefore a circuit breaker should be chosen with an ampere rating equal to the maximum load current that will be drawn by the feeder. The interrupting rating should be large enough, not only for the present conditions, but for any contemplated expansions.

The use of reactors is becoming more prevalent for several reasons. Their general function is to limit the amount of current that can flow in the system under short-circuit conditions. They also cushion or limit the effect of a short circuit or severe surge in one part of a system on the other parts. They can be used on feeders, between bus sections, or between generators and buses. Reactors can be used to prevent the necessity of replacing the breakers where a system is expanded and is at the limit of interrupting capacity of the breakers. The principal objection to the use of reactors is a somewhat poorer voltage regulation. Fig. 3 illustrates the reduction in short-circuit current and consequently in breaker capacity resulting from the use of reactors.

In discussing reactance, the term "per cent reactance" is used; for example, 5 per cent reactance. This means simply that the voltage drop through that piece of apparatus, when normal current is flowing, is 5 per cent of the total applied voltage. If the reactance is known, the maximum short-circuit current that will flow can easily be found. For example, if the reactance is 5 per cent, normal rated current will cause a 5 per cent drop in voltage, and for a 100 per cent voltage drop (short circuit), 100 per cent ÷ 5 per cent = 20 times normal current, will flow.

Each feeder should have at least an ammeter. Preferably, a transfer switch or jack should be provided for reading the current in any one of the three phases. A watt-hour meter allows the total energy consumption of each area of the plant to be observed and recorded. There should be a voltmeter on the bus, with a transfer switch, for reading the voltage of each phase. A power factor meter is a valuable addition.

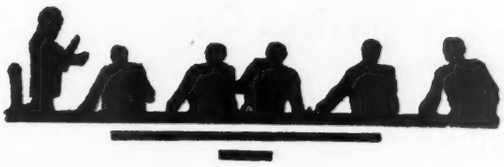
If the amount of power consumed indicates the condition of the machinery or efficiency of the operators, a curve-drawing wattmeter is desirable. In case variation of voltage or frequency affects the process, a recording voltmeter and recording frequency meter should be used.

In the succeeding article, which will appear in an early issue, distribution of energy to the point of utilization will be discussed.

■ ■

Twenty-seven hundred eighty-three (2,783) breakdowns in the Stalingrad, Russia, tractor plant in the last four months. And when it was discovered that, instead of the 50,000 scheduled, 3,000 tractors were turned out in 1930, this banner of derision, the "Order of the Laughing Camel," was placed on the walls as punishment of the workers. Maintenance thus assumes a national significance because the ultimate success of the Soviet agricultural plan depends on mass production through the use of tractors and other heavy machinery.

PLANT ENGINEERS' FORUM



Here is the twenty-second of a series of questions, each of which has at least two sides. A new question will be presented next month, and our readers' answers to previous questions also will be published. Write down your opinions and send them to the editor. Answers published will be paid for at an attractive rate.

What Qualifications for a Maintenance Engineer?

Pride of possession has brought Frank Fulleger to the home of George Shipman on a warm summer evening to display his new car. George is unusually glad to see him because he has a problem to discuss with the younger man. They have about concluded the inspection of the new car as we tune in on the conversation.

* * *

"Some boat, Frank. Glad to see you doing your bit to speed up business. Salary raised, or did you inherit money?"

"Neither, George. I merely practiced what I preach. In maintenance work we call it applying an economical program of replacement. In other words, it cost me so much to keep the old bus running that it was cheaper to turn it in for a new one."

"Great stuff, Frank. I'm especially interested in your statement because I'm looking for a maintenance engineer who knows something about economical programs."

"How's that, George?"

"Joe Hines is leaving us the first of the month to make his home in California. I like Joe—sorry to see him go—but it's a good thing in a way. Joe was a good man in the old days when there were only three in the department, but lately his job has grown faster than he. I'd offer you the job, Frank, if I didn't know how well fixed you are. Know a good man for the job?"

"So Joe's leaving. I'd have given my right arm for his job two years ago, just because I'd like to work for you, I suppose. But you're right, I am well fixed. Fact is, all the good maintenance engineers I know are pretty well satisfied. If you'll pardon my blushes, they're hard to find. Looks like you'll have to do some looking around."

"O. K., Frank. I'm depending on you for advice because this job is right up your street. You've got a good idea of the set-up of our maintenance department. Well, I think I want to go a lot further: Install a bonus system; organize a separate inspection division; give the whole maintenance job a general house-cleaning. I also want to give the new maintenance engineer authority to purchase a lot more equipment than before. What principal qualifications should he possess to handle the job?"

"Can't answer that question in a minute, George. Let's take a ride before it gets dark and we'll hash it out then. Show you how 'free-wheeling' works."

* * *

Frank certainly can supply a lot of information from his experience as a plant engineer and reciprocate in some measure for the advice George has given him in the past. Would be interesting and instructive for us if we could crowd into the back seat. But they didn't see us around, so we're not invited. Let's continue the discussion ourselves. Surely we can give George just as good advice as Frank can. At any rate, let's try.

What qualifications enable the maintenance engineer to handle his job successfully?

How much and what sort of experience should he have had? What should be his education? His personality?

(Answers to previous questions start on the following page)

READERS' ANSWERS

To Previous Questions

Initiative or Apathy?

(Question presented in the June issue)

INITIATIVE decidedly. Why wait for another to show the way? Who knows better than the maintenance engineer where and how operating conditions can be improved, both in regard to cost and method? Up-to-date, wide-awake managements expect their engineering departments to make proposals for methods of saving. They, in turn, can decide whether they wish to act according to recommendations.

The engineer who is on top of his job always is abreast of the times. He keeps himself familiarized with the latest developments in equipment. He advertises to the entire plant that he is there primarily to aid all departments in matters of cost and methods. When a production foreman needs help, he presents his difficulty to the plant engineer's office. In addition to recommendations for special equipment or changes in the old, the engineer's statement shows the anticipated savings and the period of time required for proposed changes to pay for themselves.

Approximately 50 per cent of our time is consumed in the study of improvements that originate from our office. The other 50 per cent is used in studying suggestions from other sources. The plant engineering division cannot be expected to pick up all possible improvements in manufacturing operations. Initiative should apply to the entire organization. If an outsider can come in and point out to the management where a saving could be made in the plant engineering division, I'd say there was apathy somewhere. Alert, wide-awake initiative should be a department head's recommendation of himself to his employer.

E. H. TELLEFSEN, *Plant Engineer*
The Murray Corporation of America
Detroit, Mich.

BY ALL means, let us vote for initiative if well directed. A man without it amounts to little more than a figurehead and is of little real value to his superiors who, as a result, are burdened with many details and problems from which they should be relieved.

It is the maintenance man who can discover the weak spots and limitations of the plant equipment. If he has initiative, he will set himself the task of preventing failures or, should some unforeseen breakdown occur, take steps to prevent its recurrence. He also will strive to have obsolete equipment replaced with more efficient units.

The reception given by the management to ideas and recommendations for improvements is another phase of the question that should not be overlooked. If it is the policy of the management to foster initiative, it is essential that men who consistently are doing good work—something out of the ordinary routine—be commended and, whenever possible, advanced. There is no surer method of killing the spark of ambition than to withhold a few words of well-deserved praise or to criticise and underrate a man's efforts.

J. H. PAISH
Electrical Maintenance Division
Northern Electric Company
Montreal, Quebec

IN THE well organized company, the maintenance engineer should initiative proposals for replacements, modifications, installations of new equipment, and new processes.

The maintenance engineer, through his corps of assistants, maintains records of all equipment in the plant. If certain installations or processes are, from a maintenance standpoint, the cause of frequent expenditures, it is the duty of the engineer to investigate the causes and, if necessary, revise the layout by replacing the faulty parts or by recommending a complete revamping. Obviously, broad or sweeping changes must be made in collaboration with the production and planning departments.

By virtue of his superior knowledge as regards the status, expense, and efficiency of the various machines and operations, the maintenance engineer is qualified to and should recommend such new installations and modifications wherein he can show a reduction in operating costs. Furthermore, any proposed changes initiated by other departments should be approved by the maintenance department before being put into effect.

The maintenance engineer, through the media of conventions, societies, plant visits, textbooks, and engineering periodicals, is in a position to compare the equipment used in his plant with that in others and with the latest developments and uses. These comparisons and subsequent studies lead to the evolution of new ideas, methods, and processes.

GEORGE BAGBY, *Engineering Division*
The Procter & Gamble Company
Ivorydale, Ohio

THE maintenance engineer should use initiative. Otherwise, he hardly deserves the title of engineer and should be considered more as a general foreman of maintenance.

His duty is to reduce the general cost of keeping the machinery operating, eliminate breakdowns as far as possible, and introduce new machinery and equipment.

Several years ago, when a part of our plant was run by a corliss steam engine, we had a very poor power factor. Our plant maintenance engineer showed us that, by installing a sufficiently large synchronous motor, we could bring our power factor close to unity and run the departments, formerly powered by the cor-

liss engine, for considerably less. The purchase of this equipment proved to be a 200 per cent investment. Although this installation effected the greatest percentage of saving made, many other improvements along similar lines were put into effect, such as using air instead of steam in our drop forging hammers; using oil for fuel instead of producing our own gas; installing cast-steel pinions instead of iron; and replacing old steam pipes with unit heaters.

Unless the maintenance branch of our organization constantly is suggesting new mechanical improvements, we feel that it is not keeping step with the production or sales end. Such progress has been vitally necessary since 1921 and will be even more so in the next ten years.

We have found that we obtain the best cooperation and understanding by having a research department composed of the factory manager, production superintendent, maintenance engineer, and the necessary men to work out the details of any project decided upon. Through this department passes questions on machinery, equipment, new processes of manufacture, and even new products proposed by the sales department. Before such a department was organized, both production and maintenance would look askance at each other's projects.

WILLIAM D. PLUMB, *Factory Manager*
Fayette R. Plumb, Inc.
Philadelphia, Pa.

TO KEEP alive the flame of initiative means that initiative must be provided with authority in keeping with the job. I believe that this fact applies specifically to junior executives and men responsible for efficient plant operation. Alert management always is open to constructive and cost-reducing suggestions and proposals. But such recommendations must pass through certain channels peculiar to each organization.

In a small or medium-sized plant, for instance, the head of a maintenance department may be entirely responsible for proposals, purchases, and modifications of all equipment, as well as development work. In a larger organization, or one in which maintenance is an item of greater than average importance, such an arrangement may not work so well. Therefore, it has been found advisable in many industries to place this phase of responsibility in the hands of the maintenance engineer and his assistants but for certain departments only, the remainder of the responsibility being delegated to such departments as mechanical development, efficiency, and research.

Because all equipment must be serviced and maintained by the maintenance engineer he should have as much voice as possible in its choice.

H. L. SCHULTZ
Assistant Superintendent of Maintenance
The Carborundum Company
Niagara Falls, N. Y.

INITIATIVE, indeed, is the answer to the question. The live maintenance engineer always should have before him the economical operation of his plant and never should hesitate to bring forward any suggestion that will tend to reduce operating costs.

Apathy usually is not inherent in men but often is a habit formed through repression or by having their suggestions repeatedly turned down by short-sighted executives. The cure is to buck up and keep on suggesting if you have worthwhile ideas. Test your suggestions and look at them from all angles, placing yourself as much as possible in the position of the man who is responsible for profit and loss. Then, if you still think them good, bring them to the management. A few ideas, accepted and tried, give confidence, and the mental process of considering the good and bad points, with their commercial value, develops common sense.

To initiate proposals tending to reduce costs, is the prerogative of the maintenance engineer, being a part of his job of economical maintenance and, as long as he doesn't talk out of turn or talk foolish, the interest and ideas should be appreciated, and they usually are, by right-thinking executives.

JOHN S. ISDALE, *Plant Engineer*
Factory K, International Silver Company
Meriden, Conn.

THE DICTIONARY meaning for apathy is "indifference," while the meaning for initiative is "ability for independent action." There hardly can be any choice as to which is preferable. The world pays for initiative—and pays well, but the individual pays for apathy—and finds it expensive.

Applied to the purchase of new equipment or modification of existing equipment, surely the initiative of the maintenance engineer should not only be expected, but demanded. Through interchange of ideas with other maintenance men, engineering associations, trade journals, and that never-failing source of knowledge —salesmen—who is more qualified, better equipped, and in a more logical position to suggest new ideas, equipment, and the like than the maintenance engineer?

From a personal viewpoint, a maintenance engineer should make as many suggestions as are practical. Even though all may be discarded, he will have the opportunity of observing the mental processes of the management and, in so doing, will be preparing himself for the position just above, which may be that of deciding such questions.

CHARLES S. STEVENSON, *Operating Manager*
Hall Brothers, Inc.
Kansas City, Mo.

Who Orders Repair Shutdowns?

(Question presented in the May issue)

UNQUESTIONABLY, the plant or resident engineer should order repair shutdowns. One of the prime functions of the plant engineering department is to keep the plant in A-1 operating condition through the medium of prompt repairs. It follows, therefore, that the plant engineer, through his intimate contact with the plant equipment, should specify when one of his most important duties should be performed.

Undoubtedly, conflicts will arise. The majority of repair orders emanating from the plant engineer will proceed along their even tenored way but, every so often, one will conflict with the preordained system of the production manager. When such a case arises, a solution can be derived only by a careful weighing of

the facts on the part of the plant engineer and the production manager. Obviously, the course showing the greatest probable overall economy to the company should be followed. It may be good policy in some instances to take a high maintenance cost to protect future business but, in general, such occasions are rare and the engineer should be very sure of his ground before consenting to such a proposal on the part of the production department.

In case of a conflict between the plant engineering and production departments, should facts so closely balance each other that a deadlock results, one can only resort to the general manager for decision, relying on his dictates, tempered as they are by a broader viewpoint of business condition, as the proper procedure.

JOHN G. CHRISTFIELD, *Engineering Department*
Hercules Powder Company, Inc.
Parlin, N. J.

LACK of cooperation caused the breakdown described by Frank in his talk with George. If the production superintendent had given his full cooperation, he would have worked out a way to give the machine to the maintenance department for the necessary time by banking his job.

The boss should get these two boys together by all means. The decision to shut down a machine for repair should not rest upon any one man but should be made only after careful consideration by all concerned. Frank, in this case, should have had all details worked out, determining the best time for the shutdown in cooperation with the superintendent. The superintendent then should have established a bank of production against the lost time.

Then, why the referee? Each man should work for the company's benefit. Such an objective requires cooperation. In this case, both men passed the buck, a tie-up being the result.

C. J. EMERY, *Superintendent, Motor Plant*
General Motors of Canada, Ltd.
Walkerville, Ont., Canada

WHEN the maintenance engineer and the production superintendent cannot agree, the works manager should decide when equipment should be shut down for repairs.

The plant or maintenance engineer is responsible for maintenance costs, while the production executive is responsible for producing the required quality and quantity of goods on time. Both are jointly responsible for that smoothness of operation upon which reliable service to customers, uniform quality of product, satisfaction of labor, and correct expense ratios depend. Because these men have a joint responsibility, neither should have absolute authority over a matter that vitally affects the other.

In order to protect his responsibility for maintenance costs and steady operation, the plant engineer should have the right to insist before the works manager that a given piece of equipment be shut down for repairs at a given time. To protect, in turn, his responsibility for maintaining his schedule of delivery promises, the production executive should have the right to insist that the equipment be kept in operation. In such a case, it is for the works manager to balance the probable results and to direct the course of action accordingly. He seldom will be approached in actual practice, however, because maintenance and production men usually have interests enough in common and pride enough in their abilities to arrive at the best compromise unaided.

R. A. JOHNSON, *Assistant Superintendent*
Morgan Works, Wickwire-Spencer Steel Company
Worcester, Mass.

To Whom Should the Maintenance Department Report?

(Question presented in the March issue)

IF THE maintenance department is interested only in making repairs after breakdowns it should report to the production department. But repairs after breakdowns are only half or less of its duties if it is a maintenance department worthy of the name. It should regularly inspect, adjust, and overhaul equipment, not only to prevent ruptures of the production schedule, but also to lengthen the life of the equipment, insure that maximum production is obtained from it, minimize the investment in new equipment, and prevent accidents.

The four functions last mentioned are problems relating directly to management because they concern maintenance duties other than those which deal with production interruptions. The tendency of the production department is to be interested in maintenance only after equipment has failed. Such a policy obviously is very expensive and violates the first principle of preventive maintenance.

The plan behind division of responsibility and functions is to focus the efforts of each department on a few closely connected duties. As soon as the scope of a department becomes too broad some of its duties will suffer. Undoubtedly it would be maintenance duties that would be neglected if the maintenance department were under the supervision of the production department.

For example, let us assume that the maintenance engineer believed it necessary to overhaul some equipment in order to prevent serious future breakdowns and that the work necessitated its removal from the production line. The production department would not favor such a move if it interfered with the flow of production. Is it not up to the management to decide whether or not the investment in the equipment should be risked in order to maintain production?

BERNARD SHEREFF
Standards Department, College Point Plant
American Hard Rubber Company
College Point, Long Island, N. Y.

How Valuable Are Plant Visits?

(Question presented in the February issue)

SHOULD maintenance engineers visit other plants regularly? Absolutely yes, for it not only broadens vision, but who can tell what things seen and kinks automatically picked up will be of use sometime? There is no plant, no matter how well organized, that cannot learn something from the methods of others and, when

an engineer takes the attitude that he can learn nothing from such visits, he is either egotistical or unfit to hold his position.

Naturally the employer should pay the expenses for, although the engineer is educating himself, whatever he learns will be put into practice for the benefit of his employer. Any wise employer will make it imperative that his maintenance engineer see how things are done elsewhere occasionally. There are, also, the friends made through such visits, so that in a time of stress one knows where he can call for help. These beliefs I have practiced whenever possible in my own work, and have always found that any time or money spent visiting has well repaid not only me but my employers.

A very good friend of mine, who is maintenance engineer with quite a large local firm, had an experience that I think is adequate proof of my assertion. He and I made a visit to a large corporation and, while there, they had a breakdown. He watched the repair and thought no more of it, but a little later a similar accident occurred at my friend's shop and, although it had happened before and he had taken good care of it, the thought occurred to him that he might use some of the principles seen at the plant we had visited. He did, with the result that he set up a shop record for repair on an accident of that sort. His employer asked what he had done to accomplish the job in so much less time than formerly and he truthfully told him, with the result that he was ordered to make at least one plant visit a month, and that the doors of the shop are open to any other engineer wishing to visit his plant.

I personally have received a lot of help and valuable ideas from such visits and would hate to think that I could never make a plant visit again, as it is more educational than many months of learning through hard knocks.

CHARLES R. WHITEHOUSE, *Standards Engineer*
The Holtzer-Cabot Electric Company
Boston, Mass.

Bonus for Maintenance?

(Question presented in the April issue)

WHEN I was serving my apprenticeship as a machinist back in the days of 1905 I often had to act as a cub mechanic in the repair crew, the forerunner of today's maintenance crew. It was customary to urge the repair crew to do speedy work on breakdowns, or getting new equipment running, by some sort of incentive; sometimes it was time and a half, sometimes double time, sometimes a day off with pay. I distinctly remember that those men were great workers; seemed to me they worked harder than the regular shop men and were proud to make a showing when shop equipment was tied up.

Since I have had some chance to exercise my own judgment in the matter of incentives I have been partial to giving a premium on quick repairs. I do not fix any definite value or figure a scale that the men keep in mind and get sore if they don't get.

I have the maintenance boss look over the work to be done and, if serious and needed badly, he informs the gang that the job is one that is worrying the old man—that if they get it done quickly and right, there should be something in it for them. Usually I provide them with meals, if it is a job requiring them to miss their home meals, and give them so many extra hours pay. My method always has worked very well and the men are glad of this recognition; they are always willing to work at their best.

I believe that setting regular bonus or incentive is bad for the morale of the maintenance crew. It might be a temptation for them to allow equipment to get into bad condition. Setting a standard length of time on this work would be unfair to the management or to the ability of the crew. Regular plant maintenance work is too wide and diversified to handle in any such way.

Primarily, good wages and an occasional step up in the envelop will keep things running smoother than a bonus in this branch of the plant work.

CHAS. H. WILLEY, *Superintendent of Manufacture*
Hoyt Electrical Instrument works
Concord, N. H.

What Maintenance Policy During Depression?

(Question presented in the September issue)

KEEPING plant buildings and equipment up to the minute at all times is the best maintenance policy. However, that is not always possible, especially if the plant is at maximum production. There are certain departments wherein it is impossible to do everything that is needed in the way of maintenance even on a Sunday or a series of Sundays. Time does not permit.

Breakdowns are bound to occur no matter how carefully the equipment is installed and maintained, inasmuch as the equipment is at the mercy of operators who at times become careless or leave some part of the operation to the mercy of others.

It is obvious that, if maintenance lags during peak production, the time to completely overhaul the entire plant and equipment is during a depression. Any company with enough foresight will not hamper the maintenance department by fear of cost.

As a general rule the depression cycle is well defined. In one industry it comes twice a year and has been doing so for quite a number of years. With the period of depression known, the time to plan an extensive maintenance program is while production is at its peak, so that all plans may be prepared, equipment deliveries scheduled, and everything in readiness when the period of depression arrives.

Unless the plant is equipped with sufficient spare equipment of all types, and maintains an extraordinary crew of mechanics, it is impossible to take all the motors out of service at regular intervals, overhaul the bearings, renew worn contacts, revarnish and bake windings, and so on during week ends. The same logic applies to boiler-house maintenance for unless there are spare units it is impossible to repair arches and grates, and replace tubes during a week-end shutdown. In addition, there are elevators and hoists, and other units that serve more than one purpose in production.

H. E. STAFFORD, *Electrical Engineer*
Provincial Paper Mills Ltd.
Port Arthur, Ont.

The Factory Floor

H. S. JACOBY

Chief Engineer, The H. K. Ferguson Company, Cleveland, Ohio

THE surface of the factory floor is subject to conditions that continually tend to wear it out. Not only do we have the problem of selecting the proper type of floor for a specific purpose, but, having made this choice, the materials, workmanship, and related factors must be such that a satisfactory wearing surface results.

Fundamentally, it is essential that the floor rest on a solid substantial support. A wearing surface may be highly resistive to wear inherently, but crumble to pieces in a comparatively short time simply because the base is not rigid. Although the concrete base resting on poor soil or on frozen ground may have every appearance of a good floor, cracks are bound to follow due to unequal settlement. These cracks open up under traffic, and a failure of the surface results.

Concrete Floors—There are several reasons why concrete forms the floor surface of the majority of industrial plants. For the single-story building with its floor resting on the ground surface, good design requires a concrete base regardless of the wearing surface selected. A concrete surface, placed either as a separate top coat or monolithically with the base, results in a floor cheaper than any other type.

Concrete, if proportioned correctly, provides a reasonably waterproof floor. Not only does this construction prevent dampness from the soil below, but it also permits an occupancy subject to the presence of water, such as paper mills and garages. Because of its compressive resistance, the concrete floor withstands heavy loads and, consequently, offers an ideal construction for warehouses subject to heavy concentrated storage.

To fulfill satisfactorily the service expected of it, the concrete floor must be laid with full consideration of the following items. To sustain first-floor loads it must rest on unyielding soil. Freshly excavated dirt should be tamped in place to produce uniform bearing values, or reinforced concrete used to span such areas. No floor should be placed on ground from which frost is not removed entirely; settlement is sure to follow. The floor should be placed at a sufficient elevation with reference to outside surface drainage or provided with cinder or tile drainage under the floor to eliminate moisture as much as possible. To deviate from rigid specification in concrete floor construction is false economy. A 5 in. minimum thickness is recommended, increasing it to 6 in. for heavy service, and to 8 in. for areas subject to motor truck traffic. The fine and coarse aggregate used should be tested for organic impurities, fineness, grading, and other qualifications as required by the American Society for Testing Materials. Likewise, the amount of mixing water should be limited to a maximum of 6½ gal. per sack of cement, including the water contained in the aggregates themselves, in accordance with the "water-cement ratio." A 1-min. mixing time

Concrete floors can be made to resist a reasonable amount of trucking by incorporating a metallic hardener in their finish.

TYPE OF FLOOR	RECOMMENDED FOR FOLLOWING CONDITIONS	TYPES OF MANUFACTURE	WHERE IT SHOULD BE AVOIDED	PRECAUTIONS
Concrete	Ground floors Heavy loads Moderate water Moderate trucking	Foundries Machine Shop Automatic tool Warehouse — Pottery—Glass Rayon Printing Laundry Garage	Where dust is objectionable — Concentrated acids and chemicals — Heavy trucking with metal wheels	Must be laid on well compacted subgrade — Care in curing Do not use metallic hardener in pottery or glass manufacturing plant
Asphalt Mastic	Excessive water Acids Chemicals Light loads Light trucking	Chemical plants Laboratories	Where subject to oil or grease — Heavy loads Heavy trucking High temperature	Special mastic for temperatures above 110 deg. F. — Special mastic for concentrated acids
Asphalt Block	Heavy loads Heavy trucking	Loading docks Platforms	Where subject to excessive water or acids	
Maple Flooring	Light manufacture on supported floors Moderate trucking	Textile mills Leather goods Electrical appliances Wood working Foods Painting and Finishing	Basements and ground floors subject to dampness Heavy trucking with metal wheels	Provide for expansion due to moisture — Dry-rot in subfloor construction
Maple Block (Herringbone)	Light manufacturing and trucking on ground floor and basement		Heavy manufacturing	
Wood Block Creosoted	Heavy manufacturing Heavy trucking	Automobile assembly Erection shop Machine shop Railroad shop	Where subject to excessive oil and grease Excessive heat Dehumidified atmosphere	Care to eliminate shrinkage and loosening of blocks

As an aid to the reader in comparing the several types of factory floors and the uses for which each is best adapted, the information has been summarized in the above table. It may well happen that for some given purpose some form of floor covering not mentioned here will have nearly equivalent suitability. Choice will then be governed by the conditions as they exist.

is rational and a good investment. After placing and troweling, the surface should be kept moist for at least seven to ten days to secure proper curing, during which time no traffic whatever should be permitted.

The saving in cost resulting from reducing the amount of cement, accepting any available aggregates, cutting down the mixing time, and eliminating curing is comparatively small. Following specifications, we have a floor that after long service will form an admirable base for another topping of cement, wood block, or mastic while, on the other hand, we have a floor that will not last under traffic, will be treacherous as a base for other materials, and will involve considerable expense in removal.

The concrete floor, when laid under favorable weather conditions or with inside protection, can be constructed properly in one operation, troweling the top surface monolithically as an integral part of the slab. When this construction is not practicable, as in the case of multisoty construction, the structural slab is left in a rough state to receive the topping (preferably 1½ in. thick) later on. To secure a good bond, the base should be cleaned thoroughly and wet down before the top coat is applied.

A large number of materials are on the market reputed to harden concrete floors and, where the presence of dust is a serious detriment to the manufacturing process, one or more applications of liquid hardener may be beneficial in preventing a too rapid disintegration of the surface. However, the writer strongly recommends rigid adherence to the specifications as set forth previously without too much reliance upon the so-called "hardeners."

No concrete floor with or without a hardener can withstand the continuous abuse imposed upon it by steel-wheeled trucks carrying heavy loads and making sharp turns. Here the grid-type of floor, which has steel grating buried in its upper surface, has its place.

When the service is less severe, some form of metallic or other highly resistive aggregate may be used in the wearing course. Iron, when finely divided and free from oil and properly incorporated in the cement finish, produces a resistive quality of real merit. Artificial aggregates of extreme hardness also are available.

Especially good results may be obtained from ordinary aggregates by removing the excess water from the wearing course after it has been applied to the base but before it has hardened. A proprietary method has been developed to accomplish this end in a thoroughly practicable manner, and concrete floors of the very highest quality are possible by its use.

It is good practice to provide expansion joints in concrete floors of large area, not so much for the purpose of preventing damage due to expansion, as to deliberately locate in straight lines the shrinkage cracks that are unavoidable. At foundations, walls, and wherever there is a possibility of uneven settlement, an expansion joint also is advisable. In general, expansion joints should be provided on approximately 50-ft. centers in both directions and should be located on column lines wherever possible. Filled joints are, of course, preferable but some economy may be realized by using a plastic filler for alternate joints, the remainder being

plain construction joints running the full depth of the slab without a filler. Where a concrete floor is to serve as a base for some other finish, the use of expansion joints is seldom necessary or advisable. If used at all, special care must be taken so that the squeezing out of the joint filler during expansion will not result in damage to the surfacing material by forcing it up from the base.

Asphalt Mastic Floors — Unlike concrete, the mastic floor is resilient. A casting that might break if dropped on a concrete floor probably would cause only a dent in a mastic surface. Under continual traffic and trucking, the concrete floor will dust; mastic will not originate dust under the most severe conditions.

Normally, the mastic floor possesses the same characteristics as asphalt street paving with its black color, quiet under traffic, and softening under extreme heat. It is simply a wearing surface and, having very little tensile strength, depends entirely upon the sub-base to carry the load.

Concrete makes an admirable base to support a mastic floor. This base can be left in its rough state without any special finish. Not only are expansion joints not required for inside mastic floors, but the small cracks which occur in the concrete are not reflected in the plastic surface.

Mastic flooring supported on a wood base makes a satisfactory construction providing the structure is rigid enough to prevent serious deflection and unequal settlement. Such construction usually requires a minimum of 2-in. tongue-and-grooved flooring or two layers of 1-in. flooring laid at right angles. A ply of heavy building paper or asphalt felt is laid over the base to prevent bonding with the mastic.

Because mastic floors must carry weights either moving or stationary, it is essential that the asphalt be loaded heavily with a filler. This filler in the form of sand and gravel can be incorporated only to a limited extent and, therefore, the weight resistance is limited. Heavy loads standing for some time, especially if the temperature is warm, will dent a mastic floor. Minor loads will dent it slightly but will not cause serious damage. The treads of trucks should be fairly wide, and barrels or other materials with sharp edges should be placed on boards to distribute the loads. Where temperatures above normal are anticipated, materials of higher melting point are advisable.

If chemical solutions are allowed to evaporate and concentrate or stand for extended periods on a regular mastic floor, the surface will rot in a few years and wear out under traffic. The presence of a filler reduces the resistance to corrosion. For such installations, acid-resisting mastic is recommended with its natural imported asphalt and filler of silica aggregate. As an added precaution, the floor surface should have a definite slope toward the drains and should be flushed frequently with water. This precaution is especially important in the presence of sulphuric acid.

A built-up membrane should be placed under an acid-resisting floor to prevent the acid from attacking the sub-base should cracks occur in the floor surfacing due to settlement of the building or for any other similar reason.

The same precaution should be taken in cases in which a waterproof floor is required. For an acid or water condition, the mastic floor should be about 1½ in. thick and should be laid in two separate layers with the joints broken in each course.

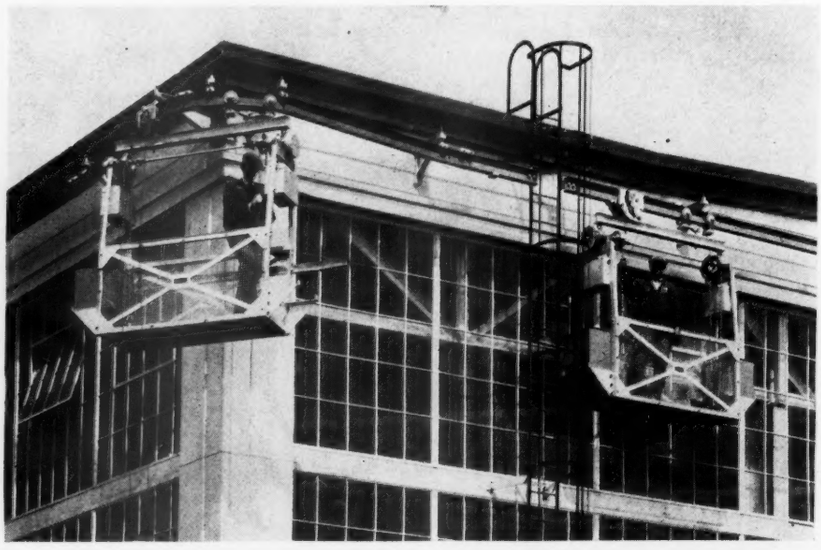
Oils and other organic liquids are solvents of bitumen and, consequently, an excessive amount of oils or greases will cause disintegration of asphalt mastic floor. As previously indicated, this type of floor is adapted especially for use in chemical plants, battery and pickling rooms, and supported floors subject to considerable water, but should be avoided in garages and machine shops in which oil and grease may come in direct contact with the floor. Also, mastic floors should be avoided where excessively high temperatures prevail, as in front of annealing or core ovens.

Mastic floors may be recommended for general factory purposes and for light trucking service. The additional cost over concrete is justifiable for the conditions that I have enumerated. A thickness of 1¼ in. should be used for foot traffic, and 1½ in. for light trucking. Joints—often the point of weakness in other types—are unnecessary in a mastic floor. Open joints against walls should be avoided by the use of 3- to 6-in. fillets.

Asphalt-Block Floors—For heavy-duty service, such as exists in freight houses, warehouses, and steamship terminals, asphalt-block flooring is recommended. Manufactured from materials of high-grade and uniform character under high pressure, asphalt blocks will not indent under heavy loads nor mark under the wheels of heavy traffic. Also, they will not soften under heat. Other characteristics are somewhat similar to the asphalt mastic floor. Asphalt blocks should not be used over a wood floor nor in the presence of acid and water, which would tend to seep through the joints.

[*Wood floors will be discussed in the concluding part of the article, which will appear in an early issue.*]

■ ■



In this plant, window cleaning gets the attention it deserves. Miniature trolley cars, carrying tanks of hot and cold water, are used to keep the 30,000 panes of glass clean in the steel tank shop of the General Electric Company, Pittsfield, Mass. Cars are propelled horizontally by a geared wheel and ratchet, and raised and lowered by chain falls.

QUESTIONS and ANSWERS

How to Salvage Gold Dust

Can you furnish information concerning the salvaging of gold dust and gold buffings from the dust-collecting system, and the reclaiming of precious metals from waste water? J. M. B.

Rochester, N. Y.

■

Methods of Cleaning Building Sandstone

Can readers tell me whether there are any practical methods, other than sandblasting, of cleaning building sandstone?

Lansing, Mich. F. E.

■

Why Did Grinding Stator Cause Trouble?

We recently had a 300-hp., 2,200-volt, three-phase, 25-cycle, 1,500-r.p.m., squirrel-cage motor in which the rotor pulled hard against the bearing opposite the pulley end. Sleeve bearings were used. The stator had 72 slots and the winding was connected single-circuit star. The rotor had 58 bars. The stator punchings were continuous rings, and the bore had been ground to size. A new stator core, not ground, eliminated the trouble. We considered it to be due to leakage flux crossing the air gap, in which the reluctance of the path was considerably less in some places than in others, due to the grinding of the stator. Will someone who has had a similar trouble please give their views on what they consider to be the cause? F. E. S.

St. Catharines, Ontario, Canada.

■

What Causes Spark on Ground Test?

When testing for grounds on a three-wire, a.c., 110/220-volt light panel with a test lamp, I often obtain a hot spark when the busbars are touched, but the lamp does not light nor will a voltmeter give any reading. Does this spark indicate a ground with a high-tension wire, or other abnormal condition? If not, what causes it?

Worcester, Mass. R. S. T.

Please submit answers promptly. We expect to publish no answers later than the second issue following the appearance of the question. Selection will be made on the basis of quality, but answers first received have the best chance of being used.

Covering Water Line to Prevent Sweating

We are having a great deal of trouble from condensation on a cold water line. The pipe has been covered twice, within two years, with an anti-sweat pipe covering of wool felt, but the covering is beginning to rot again, and will soon have to be replaced. The temperature of the room is about 75 deg. F.; the pipe carries city water and is quite cool. I should like to know if someone can recommend an effective method of eliminating this trouble.

Newark, N. J. G. W. L.

WE HAVE experienced trouble from condensation on cold water mains under conditions quite similar to those cited. There are two principal methods of overcoming this trouble: The first involves insulating the water pipe, using an insulating cover thick enough to keep the exposed surface at approximately the same temperature as the surrounding air. In the other method no effort is made to prevent sweating, but suitable means are provided for collecting and draining the condensate.

We have tried a number of schemes to prevent sweating. Different paints were applied to the pipes, and although the sweating was reduced in varying degrees by painting, in general the thickness of a paint film is not enough to prevent sweating under all atmospheric conditions. The most satisfactory insulating method tried involved wrapping the water main with chicken wire to which was applied the regular insulating plaster or cement used on steam boilers. We applied this plaster about 1½ in. thick, and after two years of service there is no indication of deterioration. There is also no evidence of sweating, and we believe that a much thinner layer would be sufficient to prevent sweating in any objectionable degree. The chief objection to this method is the comparatively high cost of the materials.

Probably the cheapest way to avoid trouble, and one that we have adopted, is to suspend an eaves trough from the water main and allow the condensate to drip into it and be drained off at some suitable point. This method is quite effective, and for most locations should not be objectionable from the standpoint of appearance.

C. W. PEDEN.

Electrical Superintendent,
Aluminum Company of America,
Massena, N. Y.

TROUBLE in preventing condensation on cold water pipes, and subsequent rotting of the pipe covering, is due to improper choice of material for that purpose. Wool felt is an excellent material in itself, but its ability to absorb moisture defeats its purpose, as it becomes soaked and eventually rots.

The best insulating covering for pipes that I have used is known as Air Cell Anti-sweat, and is made by one of the leading manufacturers of insulation. It is a paper covering consisting of concentric layers of corrugated paper with a cloth covering. It comes in lengths about 3 ft. long, which are split for slipping over the pipe; they are held in place by straps such as are used with magnesia covering.

Another method of preventing dripping that was noted recently in a New England factory was novel, although not so good in appearance as other methods. Lengths of metal gutter, such as used along house eaves, were suspended below the offending pipes and led off to the side of the room, where the drip was piped to a drain at some convenient point.

Although this scheme is not very artistic, it is simple and effective, and I can imagine some situations where it might be the answer. Possibly the one that G.W.L. finds troublesome might be that place.

Meriden, Conn. JOHN S. ISDALE.

THE PROBLEM involved here is a matter of insulation. It is necessary to present to the surrounding air a surface that is not cool enough to condense the moisture in the air. For this purpose cork is the logical material. Its value as an insulator, and its wide use in refrigerators and elsewhere, are well known.

Getting a generous covering of cork on a pipe line can be accomplished by using ground cork, first coating the pipe with tar or some of the roofing preparations that are available. Just before this material sets hard, or while it is "tacky," apply the cork, squeezing it well into the paint.

In many cases one coat of roof paint and cork will be enough, but if not it is evident that the process can be repeated as many times as needed. Incidentally, cork does not deteriorate very quickly, particularly when bonded with an agent like that described.

Peoria, Ill. JOHN E. HYLER.

■

Painting Concrete Floors to Prevent Dusting

To overcome "dusting" of the concrete floors in some of our washrooms and offices I want to paint them, and shall appreciate it if readers will answer the following questions: (1) Will paint adhere well to such floors? (2) If applied directly, will it harden the concrete sufficiently to prevent further dusting and enable it to stand reasonable traffic, or will it be advisable to apply one of the commercial floor hardeners first? (3) Is any preparation other than cleaning necessary if paint is applied directly without a hardener? (4) Can ordinary floor paint be used?

Richmond, Va. **S. V. B.**

CONCRETE is one of the most variable materials, ranging from a loose conglomeration of sand, stone, and cement to a well-hardened, seasoned mass. Hence, painting of concrete is not a standardized job.

A well-laid floor can be painted and will provide a good wearing surface. Simply sweep, wash with an alkaline solution to remove grease, and prime with a suitable primer. For the second coat, any of the standard concrete paints made by all reliable paint manufacturers may be used. If the floor is oil-soaked the oil must be removed or neutralized by using benzine or a solution of one part of muriatic acid to four parts of water.

With a poor floor it is difficult to prevent dusting. Such floors may be treated with chemical hardeners, if it is not too late, and then painted as above. The worst cases may be treated with an asphaltum-base paint; or this may be used as a primer, and a thicker coat trowelled on and rolled down. There are a number of these compounds on the market, some in colors. Even aluminum powder is used in the asphaltum vehicle. This is the most effective treatment for a badly worn or rotten concrete floor, and provides an elastic and resilient covering that will be free from dusting.

Ordinary paints are not suitable for use on concrete floors.

Meriden, Conn. JOHN S. ISDALE.

DUSTING of concrete floors can be greatly decreased and very often entirely eliminated by the use of some of the silicate fillers. There are many such preparations on the market, sold ready for application. Magnesium fluosilicate crystals may also be purchased directly and dissolved in water to make a solution that is an excellent hardener and one that prevents dusting.

All of the above materials are colorless and do not change the color of the floor, although they give it a glossy appearance.

Civil Engineer, M. L. DAVIS.
The Firestone Tire & Rubber Company,
Akron, Ohio

THERE are three methods of overcoming dusting of concrete floors: (1) Coating the floor with a concrete varnish. (2) Coating with a chemical floor hardener. (3) Coating with a concrete floor paint. Both the varnish and floor paint should be made for use on concrete floors. There is a certain amount of alkali in all concrete surfaces that is most destructive to ordinary paint and varnish. For this reason chinawood oil paints and varnishes give the best results on concrete.

In case the floor to be treated is too soft for a paint or varnish coating, it will be advisable to use a concrete hardener. Cement floors sometimes develop unusual softness, and if they do not make a good foundation for paint it is necessary to provide such a foundation. Wherever the floor seems to be sound, with no tendency to spall off, I would not recommend the use of a floor hardener before painting; it is often found that a hardener makes the floor too dense, so that the paint will not adhere well.

On the whole, I believe that for office floors varnish or paint are more satisfactory than a chemical floor hardener, because they provide a film that makes the floor non-staining. Paint is much more decorative than varnish, but has a tendency to wear off in places where traffic is concentrated, and may need repainting once or twice a year. To avoid this, varnish is often used.

No preparation other than ordinary cleaning is required when paint is applied to a concrete floor, without the use of a hardener. Of course, the surface must be clean, dry, and free from grease, oil, and any foreign matter that would prevent adhesion of the coating.

When paint or varnish is used on a concrete floor, instructions must be given to the janitors not to use ammonia or strong solutions of alkali when cleaning the floor.

H. G. DOERING.
The Truscon Laboratories,
Detroit, Mich.

■

Trouble with Field Coil of Elevator Motor

Will someone please give me help on the following question? One of our elevators is operated by an Imperial Electric 15-hp., 220-volt, 850-r.p.m., d.c. motor. It is a four-pole, compound-wound, interpole machine, with Cutler-Hammer control. One of the field coils is giving us a great deal of trouble by burning out or becoming grounded within a week to a month after installation. The other field coils do not give us any trouble. I have checked up all of the connections and apparently they are correct. How can I determine what causes this one field coil to burn out or ground?

New York, N. Y. **J. B. S.**

IF THE field circuit in general becomes grounded it would indicate that the field discharge resistor is defective, but it is unlikely that the same coil would become grounded every time trouble develops in the motor, assuming that the coil was reinsulated with the equivalent of its original protection.

I suggest that J. B. S. make sure that this polepiece is seated solidly against the frame, if it is of the bolted type, and that there is no foreign material under it. If the poles are laminated, check the laminations to see whether they have been jammed together or perhaps burned together by an arc to ground.

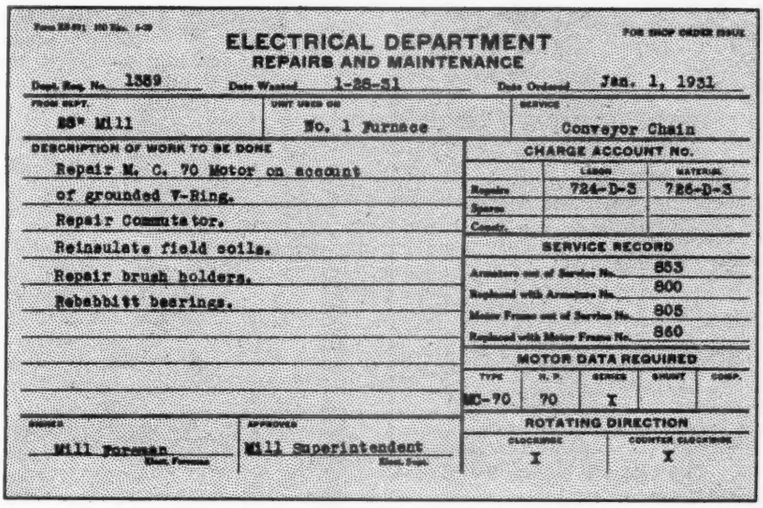
When the coil is replaced check the pole for burrs or burned places that might cut the insulation when the coil is being pressed on the polepiece. Rough or burned places should be filed or ground smooth.

Check the polarity of this coil to make sure that it is correct, and test the series field to see that it is not short-circuited to the shunt field. Make sure that there is plenty of insulation between the series and shunt coils. If this field coil has been rewound recently it would be advisable to check the size of wire and number of turns or weight with one of the other coils.

GRADY H. EMERSON.
Birmingham, Ala.

Second article of a series of three

FRED W. ACKER
Assistant Superintendent
Electric and Power Departments
Inland Steel Company, Chicago, Ill.



ELECTRICAL DEPARTMENT
REPAIRS AND MAINTENANCE

Dept. Req. No. 1389 Date Wanted 1-28-31 Date Ordered Jan. 1, 1931

FROM DEPT.	UNIT USED ON	SERVICE
28" Mill	No. 1 Furnace	Conveyor Chain

DESCRIPTION OF WORK TO BE DONE

Repair M. C. 70 Motor on account of grounded V-Ring.
Repair Commutator.
Reinsulate field coils.
Repair brush holders.
Rebabbitt bearings.

CHARGE ACCOUNT NO.

	LABOR	MATERIAL
Repairs	724-D-3	726-D-3
Spares		
Constr.		

SERVICE RECORD

Armature out of Service No. 853
Replaced with Armature No. 800
Motor Frame out of Service No. 805
Replaced with Motor Frame No. 860

MOTOR DATA REQUIRED

TYPE	H. P.	SERIES	SHUNT	COMP.
MC-70	70	X		

ROTATING DIRECTION

CLOCKWISE	COUNTER CLOCKWISE
X	X

ISSUED Mill Foreman (Elect. Foreman)
APPROVED Mill Superintendent (Elect. Supt.)

Fig. 6—The "Electrical Department Repairs and Maintenance Requisition" is a written request on the electrical shop to perform a given repair operation. It is the first link in our bonus system for obtaining accurate repair costs.

Maintenance on Incentive

How incentive is applied in the electric repair shop

MOST manufacturing companies have been paying their production men a premium for extra accomplishment. Such procedure has been successful. The Inland Steel Company has been a pioneer in so rewarding the individual accomplishments of employees. It has extended the incentive plan by making available to the maintenance men in the electric repair shop a premium on individual repair jobs.

We can best explain this system by following a job through our repair shop. The forms used are simple, the results are accurately compiled costs, and the conclusions are that both parties get their money's worth. Let us see.

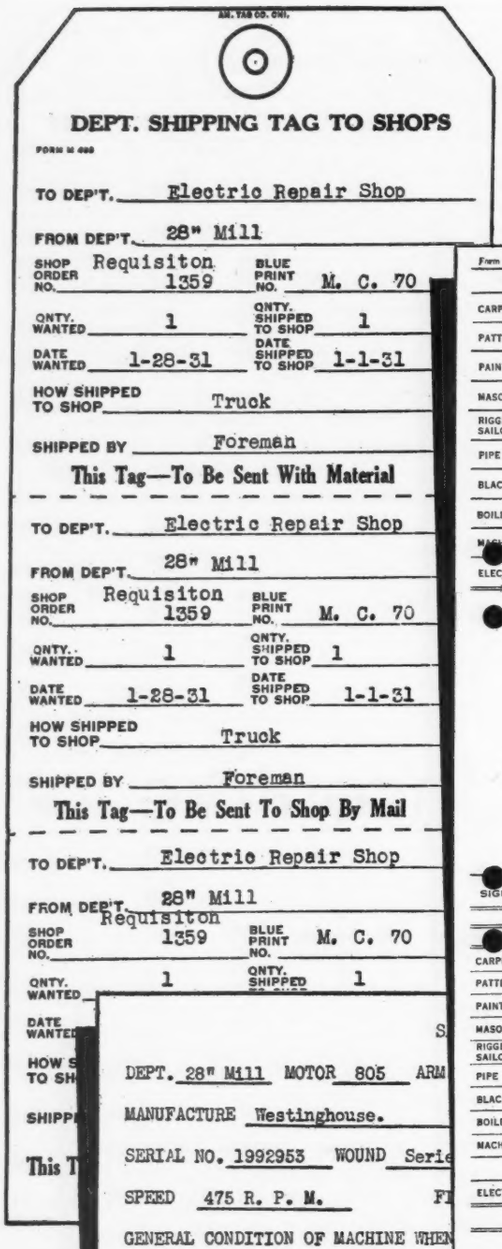
The job is begun in the mill when the electrical foreman prepares the "Electrical Department Repairs and Maintenance" requisition, Fig. 6, which is made out in triplicate, on white, pink, and blue paper. The white copy, after receiving the mill superintendent's approval, is mailed to the electrical repair shop foreman. The pink copy goes to the electrical superintendent to be returned with his comments. The blue copy stays in the issuer's book as a record of the work performed outside of his organization.

This form starts out by giving the department's requisition number, date wanted, and date ordered. It next sets forth the department's name, unit on which used, and the service. The space provided for the description of the work to be done is self-explanatory and sufficiently large to permit a full statement concerning the extent of the repairs to be made. The charge account number designates whether the work is for repair or construction, and gives the account numbers to be charged for the work. It also contains the necessary data for compiling and maintaining an accurate equipment service record. This will be discussed in a later article.

A blue shipping tag, Fig. 7, is used to identify the apparatus shipped from the field to the repair shop. It is prepared by the mill foreman and is attached to the equipment when he prepares the requisition. The middle section of the tag is torn off and mailed to the repair shop. On receipt of the equipment at the shop this first section is signed on the back and is returned as a receipt. The end section is retained by the sender until he receives the receipted end from the shop.

As soon as the equipment, which in this case is an M.C. 70 motor, arrives, an inspection report, Fig. 8, is prepared in duplicate by the shop inspector and is given to the shop foreman. This report specifies the actual work required to perform the task.

A copy is mailed to the mill foreman whose motor is being repaired.



DEPT. SHIPPING TAG TO SHOPS

TO DEP'T. Electric Repair Shop
FROM DEP'T. 28" Mill
SHOP ORDER NO. Requisiton 1359
BLUE PRINT NO. M. C. 70
QNTY. WANTED 1
QNTY. SHIPPED TO SHOP 1
DATE WANTED 1-28-31
DATE SHIPPED TO SHOP 1-1-31
HOW SHIPPED TO SHOP Truck
SHIPPED BY Foreman
This Tag—To Be Sent With Material

TO DEP'T. Electric Repair Shop
FROM DEP'T. 28" Mill
SHOP ORDER NO. Requisiton 1359
BLUE PRINT NO. M. C. 70
QNTY. WANTED 1
QNTY. SHIPPED TO SHOP 1
DATE WANTED 1-28-31
DATE SHIPPED TO SHOP 1-1-31
HOW SHIPPED TO SHOP Truck
SHIPPED BY Foreman
This Tag—To Be Sent To Shop By Mail

TO DEP'T. Electric Repair Shop
FROM DEP'T. 28" Mill
SHOP ORDER NO. Requisiton 1359
BLUE PRINT NO. M. C. 70
QNTY. WANTED 1
QNTY. SHIPPED 1
DATE WANTED
HOW S... TO SH...
SHIPP...
This T...

Fig. 7—The "Department Shipping Tag to Shops" is a complete shipping manifest. The first detachable section is kept as a receipt by the department sending material. The middle section is mailed to the shop as notification of shipment. The remaining stub is placed on material going to shop. Blue designates shipments from the field to the repair shop.

Form 261M

SHOPS	SEND ORDERS TO
CARPENTER SHOP	
PATTERN "	
PAINT "	
MASON "	
RIGGERS (SAILORS) "	
PIPE "	
BLACKSMITH "	
BOILER "	
MACHINE "	X
ELECTRICAL "	X

INLAND STEEL COMPANY
SHOP WORK ORDER

No. F-9999-T

DEPT. NO. 15---T DATE January 1, 19 31

PLEASE DO THE FOLLOWING WORK AS DIRECTED BELOW:

FOR 28" Mill DEPT.
NAME OF UNIT No. 1 Furnace
Conveyor Chain

CHARGE DEPT.	CONST.	REPAIRS	SPARES	CHARGE ACCOUNT NO. LABOR	MATERIAL
28" Mill		X		724-D-3	726-D-3

BLUE PRINT NO.
DATE WANTED January 28, 1931

DESCRIPTION OF WORK TO BE DONE

M. C. 70 Motor. Repair grounded V-Ring.
Repair Commutator.
Reinsulate field coils.
Repair brushholders.
Rebabbitt bearings

Weld and redrill dowel holes in jack shaft bracket.

Armature out of Service No. 855
Replaced with armature No. 800
Field Frame out of Service No. 805
Replaced with frame number 860.

SIGNED Mill Foreman APPROVED Mill Superintendent GEN. MASTER MECHANIC

SUMMARY OF COST

SHOPS	MATERIAL DESCRIPTION	MATERIAL WEIGHT	MATERIAL COST	LABOR	EXPENSE	TOTAL COST	REMARKS
CARPENTER SHOP							
PATTERN "							
PAINT "							
MASON "							
RIGGERS (SAILORS) "							
PIPE "							
BLACKSMITH "							
BOILER "							
MACHINE "	Weld and redrill dowel holes in Jack Shaft bracket			8.00	3.70	11.70	
ELECTRICAL SHOP	Given above		85.06	51.72	30.10	166.88	
					TOTAL COST (ALL SHOPS)	$ 178.58	

PLEASE RETURN THIS ORDER TO THE GENERAL MASTER MECHANICS OFFICE WHEN COMPLETED

Fig. 9—The "Shop Work Order" is the summary of all shop activities on a given job. When the shop costs are compiled they are recorded in its "Summary of Cost."

DEPT. 28" Mill MOTOR 805 ARM...
MANUFACTURE Westinghouse.
SERIAL NO. 1992953 WOUND Serie...
SPEED 475 R. P. M. F...
GENERAL CONDITION OF MACHINE WHEN...
Mica V-Ring grounded. Armature bands off. Grounded main field coil and commutating coil needs reinsulating.
REPAIRS MADE Same.

CHECK FOR BEARINGS 1 Bearing; broken babbitt.
CHECK FOR END PLAY excessive
FIELDS TESTED FOR POLARITY O. K.
FIELDS TESTED FOR SHORT One Commutating coil shorted.
FIELDS TESTED FOR GROUND One main coil grounded.
FIELDS TESTED FOR NEUTRAL O. K.
BRUSHES SANDED IN Yes.
W. F. C. (Signed) Fred Greenough

Fig. 8—The "Inspection Report" is the diagnosis of the condition of the equipment to be repaired. Unless objection is made, the repair shop is assured that the field is satisfied with its findings.

If he disagrees with the statement of condition of the motor he can make an inspection in the presence of the repair shop foreman. This provision eliminates controversies at a later date by permitting the sender to see the actual condition. The inspection report is also used in preparing the "Shop Order" cards and the "Shop Work Order."

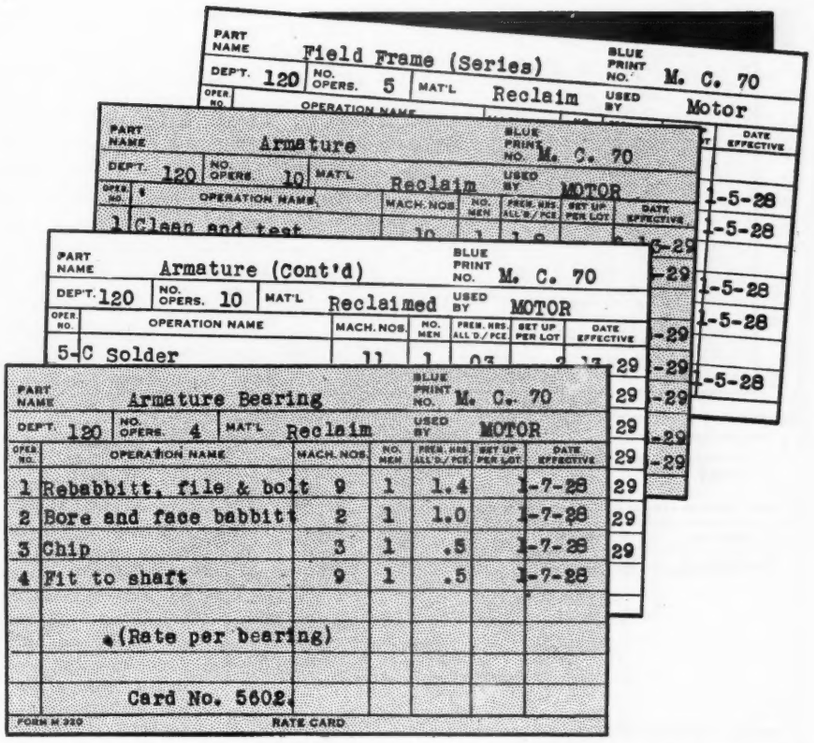
The "Shop Work Order," Fig. 9, is the summary of all shop activities on this job. It is prepared in quadruplicate. The fourth copy is mailed immediately to the mill superintendent who is charged with this job, without the cost recorded thereon, and serves as a notice of the work being performed.

The top section of this form merely tabulates the data contained on the requisition with the addition of the electrical repair shop's order number in the upper right-hand corner. It also contains in the upper left-hand side a space for showing what departments other than the electrical are working on the job.

The middle section describes the work actually being performed. It also contains the necessary records of the equipment changed for keeping the service record cards up to date.

The "Summary of Cost" section is efficient in summarizing the total cost items. When the job is completed this section sets forth the major costs, such as costs of material, labor, and overhead, for each department having worked on the job.

After the costs are compiled the original is mailed to the accounting department for compilation of expense against the account number shown. The second copy goes to the mill superintendent having the work performed, while the third copy goes to the electrical superintendent's office, where the costs are recorded on the equipment cards, after which it



PART NAME: Field Frame (Series) — BLUE PRINT NO.: M. C. 70
DEPT.: 120 — NO. OPERS.: 5 — MAT'L: Reclaim — USED BY: Motor

PART NAME: Armature — BLUE PRINT NO.: M. C. 70
DEPT.: 120 — NO. OPERS.: 10 — MAT'L: Reclaim — USED BY: MOTOR

OPER. NO.	OPERATION NAME	MACH. NOS.	NO. MEN	PREM. HRS. ALL'D / PCE.	SET UP PER LOT	DATE EFFECTIVE
1	Clean and test	10				1-5-28
5-C	Solder	11	1	.03		1-5-28

PART NAME: Armature (Cont'd) — BLUE PRINT NO.: M. C. 70
DEPT.: 120 — NO. OPERS.: 10 — MAT'L: Reclaimed — USED BY: MOTOR

PART NAME: Armature Bearing — BLUE PRINT NO.: M. C. 70
DEPT.: 120 — NO. OPERS.: 4 — MAT'L: Reclaim — USED BY: MOTOR

OPER. NO.	OPERATION NAME	MACH. NOS.	NO. MEN	PREM. HRS. ALL'D / PCE.	SET UP PER LOT	DATE EFFECTIVE
1	Rebabbitt, file & bolt	9	1	1.4		1-7-28
2	Bore and face babbitt	2	1	1.0		1-7-28
3	Chip	3	1	.5		1-7-28
4	Fit to shaft	9	1	.5		1-7-28

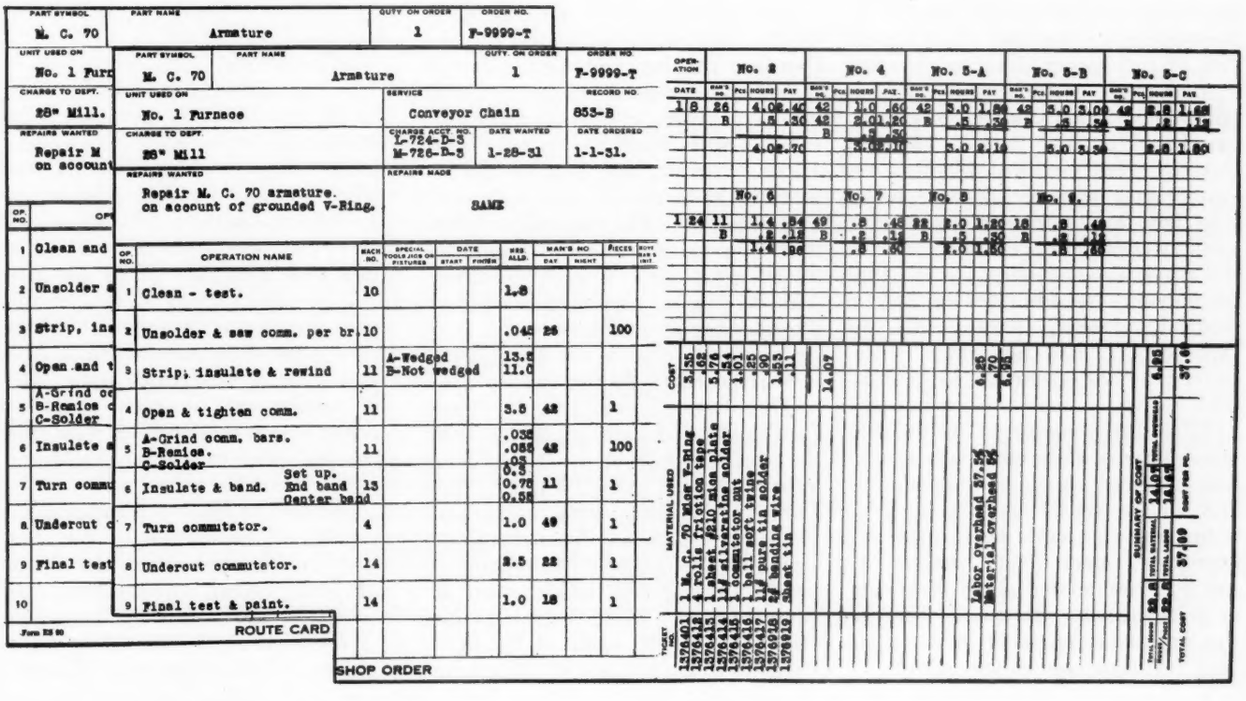
(Rate per bearing)

Card No. 5602.

FORM M 320 — RATE CARD

Fig. 10—Operation of the incentive system is based on the workman's being allotted a reasonable time to do his task. Allotted time for each operation is kept on a master card.

Fig. 11—On each shop order three sets of route cards are required in repairing a complete motor. These cards are prepared from data taken from the "Shop Work Order" and "Master Rate Cards." The cards for "Armature" are shown. The two other sets of cards are for "Armature Bearings" and "Field Frame."



PART SYMBOL: M. C. 70 — PART NAME: Armature — QUTY. ON ORDER: 1 — ORDER NO.: F-9999-T
UNIT USED ON: No. 1 Furnace — SERVICE: Conveyor Chain — RECORD NO.: 853-B
CHARGE TO DEPT.: 28" Mill — CHARGE ACCT. NO.: L-726-D-3 / M-726-D-3 — DATE WANTED: 1-28-31 — DATE ORDERED: 1-1-31.
REPAIRS WANTED: Repair M. C. 70 armature. on account of grounded V-Ring. — REPAIRS MADE: SAME

OP. NO.	OPERATION NAME	MACH. NO.	SPECIAL TOOLS JIGS OR FIXTURES	DATE START	DATE FINISH	HRS. ALLD.	MAN'S NO. DAY	MAN'S NO. NIGHT	PIECES	INSP'R'S INIT.
1	Clean - test.	10				1.0				
2	Unsolder & saw comm. per br	10				.045	26		100	
3	Strip, insulate & rewind	11	A-Wedged B-Not wedged			13.5 11.0				
4	Open & tighten comm.	11				3.5	42		1	
5	A-Grind comm. bars. B-Remica. C-Solder	11				.035 .055 .05	42		100	
6	Insulate & band. Set up. End band Center band	13				0.5 0.75 0.5	11		1	
7	Turn commutator.	4				1.0	49		1	
8	Undercut commutator.	14				2.5	22		1	
9	Final test & paint.	14				1.0	18		1	

ROUTE CARD — SHOP ORDER

OPERATION: No. 2 | No. 4 | No. 5-A | No. 5-B | No. 5-C | No. 6 | No. 7 | No. 8 | No. 9

MATERIAL USED: 1 M. C. 70 Mica V-Ring; 4 rolls friction tape; 1 sheet #210 mica plate; 1 roll varnished cambric; 1 roll varnished tape; 1 roll soft wire; 1 ball soft wire; 1½ pts. tin solder; 2# bandage wire; sheet tin

Labor overhead 37.5%; Material overhead 15%

SUMMARY OF COST: TOTAL MATERIAL 14.07; TOTAL LABOR 14.62; TOTAL OVERHEAD 6.95; TOTAL COST 35.64; COST PER PC. 37.09

RETURNED JAN 13 11 4- AM '31
ISSUED JAN 13 10 6- AM '31

EMPLOYEE'S NAME	OCCUPATION	EMPLOYEE'S NO.
John Doe	Winder	3227

DETAILED DESCRIPTION OF WORK ENABLING OFFICE TO MAKE PROPER CHARGE

Armature - # 40" Rolling Mill - Plt. 2, # 1 Furnace Chain

ISSUING DEPT.	MACH. NO.	SHOP ORDER NO.	BLUE PRINT OR PART NO.	SUPT. NO.
120	14	F-9999-T	M. C. 70	

OPER. NO.	OPERATION NAME	PCS. FIN.	PREM. HRS. ALLOWED PER PCE.	DEPT. CHARGED
9	Final test & paint 1		1.2	40" Mills

ACCOUNT NO. 726-D-3

FINISHED	NOT FIN.	TRANSF'D.	BOR. DOWN	CAUGHT UP	RATE
X					.72 1/2

	HOURS	MONEY
TOTAL HRS. ALLOWED	1.2	
TOTAL HRS. ELAPSED	.8	
BONUS HRS.	.2	
CARD ELAPSED HRS.	.8	
TOTAL CARD HRS.	1.0	
TOTAL CARD MONEY		.73
TOTAL FOR DAY		

GENERAL FOREMAN'S O. K. FOREMAN'S O. K. ASST. FOREMAN'S O. K. REMARKS X CONST.

FORM T-388 INLAND STEEL COMPANY

Fig. 12—All jobs paying a premium must have the time card O.K.'d by the assistant shop foreman before it is checked out as completed. An entry is made on the back of shop order to show the time and bonus money earned.

Form M 887 25M 6-30

PREMIUM SLIP

3227 DATE Jan. 13, 19 31

YOUR PREMIUM EARNED FOR THE ABOVE DATE IS AS FOLLOWS:

ORDER NO.	PART NO.	PREMIUM HRS. EARNED	HOURLY RATE	AMOUNT PREM. EARNED
F-9999-T	M. C. 70	.2	.725	$0.15
	TOTAL			

SIGNED Colglazier (TIME-KEEPER) APPROVED Fred Greenough (GENERAL FOREMAN)

Fig. 13—If a premium is earned on a job a premium slip is given the workman at the start of the next day to show that he earned on the previous day so much money for his additional efforts.

is filed numerically according to the shop order number.

Operation of the incentive system is based on the workman's being allotted a reasonable time to perform his task. If he accomplishes it in less time he is awarded a premium of half the time he has saved. The allotted time to perform the task is recorded on a master rate card, Fig. 10. These master rate cards are prepared by the industrial efficiency engineer, who comes directly under the general superintendent. This man spent a great deal of time, when the incentive plan was adopted, in studying the various operations. The studies were compared with existing data on the same class of work performed before the system was started and on similar jobs before a rate was set. Three cards were then prepared, one for the repair shop, another for the time department, and the third for the industrial engineer's file. Before the cards can be used they must be approved by the electrical superintendent.

When the system was installed the entire time of the industrial engineer was required to make time studies. But, in the repair shop in the steel industries, the work performed is a repetition, steel plants having as many as 100 motors of one type. After three years of successful operation the industrial engineer now makes very few time studies per month.

In explaining these rate cards let us look at the forms shown in Fig. 10. Three cards are required in connection with the complete repair of an M.C. 70 motor. Separate cards are prepared as follows: One for the field frame, another for rebabbitting armature bearings, and a third for repairing the armature. Since the armature requires ten operations, part of the items are continued on the reverse side of the card.

The top of the card gives the name of the part being repaired, the department number, and the number of operations required. The operation numbers, when used on master rate cards, always stand for specific operations. For example, 5-B, on the armature card, always means "remica commutator." The important information given is "premium hours allowed per piece" for each operation. The card tells, also, the number of the machine on which the work is to be performed, and the number of men required to do the job.

The "shop order" and "route card," Fig. 11, are prepared from the data contained in the "Shop Work Order" and "Master Rate Card." The shop work order provides such data as department and equipment identification, repairs to be performed, and delivery and account numbers, while the master rate card provides the name of the operations to be performed, machine numbers, hours allowed to perform the task, etc. Three of these cards are required to completely repair a complete motor. One is devoted to armature repairs, one to armature-bearing repairs, and one to field-frame repairs.

The route card is the same as the shop order, except that its back is blank, and is the carbon copy. It is placed in a leather envelope with a celluloid front and is hung on a planning board, where it remains until the workman is ready to start the job. It then accompanies the job in the shop until the job is finished.

The reverse side of the shop order card is provided with two spaces, one for recording material requisitions and their cost, and the other for recording complete time data. The summary of these two costs is recorded in summary of cost section, at the bottom of the card. This card remains on the foreman's desk, where he can check the progress of the work on a moment's notice by the number of finished operations.

The recording of the labor data is worthy of our careful thought. The time allowed for each operation is recorded, together with the man's check number. For example, Fig. 11, the workman whose number appears under column marked "Man's No.," performed operation No. 2 in 4 hours and was paid $2.40 for this time. He also earned 30 cents bonus money for having performed the task in less time than was allotted. This bonus time is designated by a "B." The labor cost of each operation number is first totaled after which the totals are added to arrive at the grand total of the labor cost.

Total cost of labor and material, as compiled at the bottom of the shop order, is transferred to the "shop work order" card, which is then filed in the electric repair shop file.

The time card, shown in Fig. 12, is prepared by the shop clerk, who also

stamps on the card the time when the job is started and completed. If the work on any item is not finished at the end of a day, a new time card must be issued. All jobs that pay a premium must have the time card O.K.'d by the assistant shop foreman before it is checked out as completed. An entry is made on the back of the time card to show the time and bonus money earned.

If a premium is earned by the workman, a premium slip for each job, Fig. 13, is given him at the start of the next day, showing that he earned on the previous day so much money for his added efforts. If he disagrees with the amount shown on the slip he is required to discuss it with his foreman who will make any necessary adjustments on the time slip before it goes to the time department. The workman will receive a corrected premium slip. These slips remain in his possession so he can check his wages at the end of a pay.

The "Order for Stores Material" requisition, shown in Fig. 14, is used in drawing material from the storeroom. It has a number and is made out in duplicate, requiring the signature of the superintendent or his assistant. Each requisition is numbered and, before being presented to the storeroom in duplicate, its number and a description of the material are recorded on the back of the shop order card so that the data may be duplicated if the requisition is lost.

The original requisition, after the price and commodity number have been applied, is mailed by the storeroom to the time department, where the cost is applied against the account number shown thereon. It is then mailed to the department superintendent being charged for the material, so that his organization can check to see if the charge is correct. This eliminates future controversy on material charges when everyone has forgotten about the job involved.

In the meantime the carbon copy is priced and returned to the electric repair shop, where the cost is recorded on the shop order. It is then mailed to the mill superintendent who matches it with the original which he received from the time department. After approving the original he returns it to the time department where it is filed. If he fails to return the original it is proof that the charge is correct. The carbon copy remains in the superintendent's office.

The completed job is returned to the mill by attaching an orange-colored tag, Fig. 15. The first section of this tag is detached and mailed to the department superintendent receiving the motor. The middle section is retained in the repair shop until the torn-off end is returned as a receipt of the equipment arriving in the field. The end with the wire is attached to the motor.

Those having received a bonus for good service performed can best appreciate what our incentive system has meant to the men. But the results to our company can be explained best by saying that the system has reduced our shop force about 50 per cent and has helped in the elimination of all Sunday and night work. This is sufficient proof to show that the added speed did not decrease the quality of workmanship. In fact, the quality is far better because the men have their hearts in their work.

[*The first article was published in the July issue. The concluding article will be published soon.*]

Fig. 15—An orange-colored shipping tag is used by the repair shop when sending material to the field.

Fig. 14—An "Order for Store Material" carries only one item of material, making for easier tabulation in the accounting department.

AMERICAN TAG CO., CHICAGO

SHOP SHIPPING TAG

FORM M 465

TO DEPT. 40" Rolling Mill - Plt. 2.
FROM DEPT. Electrical Repair Shop
SHOP ORDER NO. F-9999-T BLUE PRINT NO. M. C. 70 Motor
QUTY. ON ORDER 1 QUTY. SHIPPED 1
DATE SHIPPED January 25, 19 31
HOW SHIPPED Truck
SHIPPED BY Foreman
INSPECTED BY Asst. Foreman
RECEIVED BY

This Tag—To Be Sent With Material

TO DEPT. 40" Rolling Mill - Plt. 2.
FROM DEPT. Electrical Repair Shop.
SHOP ORDER NO. F-9999-T BLUE PRINT NO. M. C. 70 Motor
QUTY. ON ORDER 1 QUTY. SHIPPED 1
DATE SHIPPED January 25, 19 31
HOW SHIPPED Truck
SHIPPED BY Foreman
INSPECTED BY Asst. Foreman
RECEIVED BY

This Tag—To Be Sent To Dep't. By Mail

TO DEPT. 40" Rolling Mill - Plt. 2.
FROM DEPT. Electrical Repair Shop.
SHOP ORDER NO. F-9999-T BLUE PRINT NO. M. C. 70 Motor
QUTY. ON ORDER 1 QUTY. SHIPPED 1
DATE SHIPPED January 25, 19 31
HOW SHIPPED Truck
SHIPPED BY Foreman
INSPECTED BY Asst. Foreman
RECEIVED BY

Be Kept By Shop Sending Material

Form 8-327

INLAND STEEL COMPANY
INDIANA HARBOR WORKS

Order for Store Material

No. 234243

THIS REQUISITION MUST BE PROPERLY SIGNED, CONTAIN BUT ONE ITEM, AND A CLEAR EXPLANATION FOR WHAT IT IS TO BE USED—OTHERWISE STOREKEEPER MUST DECLINE TO FURNISH.

SHOW SHOP ORDER No. AND DEPARTMENT No. WHENEVER POSSIBLE

DATE Jan 1, 19 31

REPAIRS	CONSTRUCTION
X	

FOR 40" Rolling Mill - Plt 2 DEPT.

TO BE USED FOR No. 1 - Furnace Chain

NO.	ARTICLE	BIN NO.
1	M. C. 70 - 70 HP., Front Mica	
	V-Ring S#155952	

RECEIVED BY
NO.
SIGNED Foreman or Assistant SUPT. OR FOREMAN NO.
DEPT. SUPT.: WHEN THROUGH WITH THIS ORDER RETURN TO TIME DEPARTMENT FOR FILING.

SHOP ORDER NO. F-9999-T

DEPT. NO.	ACCT. NO.
15	726-D-3

GROUP NO.	COMMODITY NO.
	70-901

WEIGHT OR QUANTITY

PRICE PER UNIT 3.50

TOTAL VALUE $3.50

ORDER FILLED BY
No.

MAINTENANCE ENGINEERING

L. C. MORROW, Editor

AUGUST, 1931

Summer's Winter Duties

POSSIBLY no admonition is needed, but here is one, nevertheless. Accept our reminder that, though you are being broiled in August, you'll have opportunity to be more than chilly within the next few months.

And with that consciousness, look now to the heating equipment. Locate the areas in the plant where chills raced up and down spines last winter, where drafts hit the backs of necks, and where feet constantly reminded their owners of a close relationship. Then put in the needed heating equipment, add storm doors, repair windows, and what not.

Think of the lighting while you're looking ahead to cold weather. Easily forgotten now, artificial light will be most important when days are short. There is not much excuse for poor light. Equipment, in both initial and operating costs, is relatively cheap. The summer months afford time for installation. And any electrical department that is operated according to planned procedure can find the man-hours necessary for the work of installation.

Russia and Maintenance

NO GROUP of industrial leaders realizes the importance of efficient maintenance more than do those desperately at work in Russia struggling to carry out the five-year plan. One example will substantiate this point more vividly than would many generalities.

According to a news report, at the Stalingrad Tractor Works, claimed to be the largest in the world, there have been 2,783 breakdowns of machinery in four months. Production for 1930 was 47,000 tractors short of the scheduled 50,000.

There can be little doubt that the exorbitant number of breakdowns was an important contributing factor to such staggering production shortage. Lack of familiarity with machines and equipment on the part of the operating and maintenance forces must have been the principal cause of the excessive number of breakdowns.

Probably this example is an extreme case but, according to numerous reports, not so extreme that we cannot conclude logically that the difficulty of developing efficient maintenance forces and operators is a grave obstacle in the consummation of the Soviet experiment. Having the necessary capital, the building of the huge plants by American engineers employing Soviet labor has been a simple task compared to the difficult, perhaps impossible, job of giving the Russian farmers, laborers, and clerks the thorough understanding of equipment necessary for adequate operation, maintenance, and repair. The long and varied experience and technical training necessary to a successful maintenance engineer cannot be obtained in a few years or less of intensive training, especially if those being taught are thrust from farms or shops into a bewildering environment of strange machines.

Such examples show how far incompetent operation and maintenance of equipment, new and modern though it may be, may go to cripple an industrial plant. An American plant with such a record would soon be bankrupt.

Recipe for a Maintenance Engineer

PARADOXICAL though it may seem, the outstanding maintenance engineer is the man with a good imagination. Even during the old "fix-it" days that was true. All of us know some of the wonderful jobs done with hay wire. Many maintenance men were hay-wire mechanics, just as naturally as women are (or were) hat-pin and hair-pin mechanics. In industrial plants the disadvantages of limited tools and limited authority had to be offset by an abundance of imagination.

A story in June *Maintenance Engineering* cited many fine examples of the use of imagination by the steel mill maintenance crew of 50 years ago. Needed tools and gages had to be made. Pumps that, on Saturday of each week, "looked like they couldn't last the day out" were kept going "year after year and did their part to keep the product moving." "Shutdown was just about an unpardonable sin with little hope of redemption." Yes, men with imagination ran the job in those days.

Such men still are on the job. Recall the three major articles in last month's *Maintenance Engineering*. No lack of imagination was shown by the men who visualized the equipment modernization program in the Champion Coated Paper plant; the possibilities of savings in indirect expense in the Ryerson plants; and the cost-cutting that was a result of the payment for maintenance work on the incentive basis in the mills of the Inland Steel Company.

Fifty years ago imagination was a necessary asset in placing equipment back into operation

after it had failed. Today imagination enables the maintenance engineer to see in advance how to prevent failure, how to prevent interruption to production, how to prevent the unnecessary expenditure of money in the vital function of keeping the plant going. A plentiful amount of imagination mixed with appropriate quantities of knowledge, common sense, and energy constitutes a recipe for a maintenance engineer that is just about ideal.

Weigh These Two Proposals for Reducing Indirect Expenses

POINTED out at the Production Conference of the American Management Association was the existence of opportunity to lower costs by better control of indirect expenses. Raymond S. Perry, vice-president of the Ingersoll Milling Machine Company, proposed two plans for corrective effort:

1. Through curtailment, refinement, and careful control of the activities of the indirect worker.

2. Through a possible regrouping and further specialization within an industry of these same functions.

The first plan was explained as primarily one of establishing cost standards for overhead departments. The second involves the pooling of indirect labor expense by similar industries in specific localities.

These proposals are constructive. There exists much evidence that plant activities resulting in expenditures for indirect labor offer attractive opportunities for cost cutting. Obviously the first plan is feasible. The expenditures for indirect labor itself can be reduced. More important still, expenditures (losses) caused by interruption to production can be reduced. It is even conceivable that, in some plants, an increase in the expenditures for indirect labor might so greatly reduce the cost of production tie-up that the result would be increased net profit. Putting the proposals into effect would involve planning, budgeting, methods of wage payment, selection of equipment, selection of personnel.

So far as the second plan is concerned, it is not untried. Particularly among the smaller plants, and more especially as regards electrical work, the "outside" shop has been employed. Many so-called motor repair shops serve two or more of the smaller industrial plants (sometimes on definite contract) in the installation, inspection, and repair of electrical equipment. For the most part the small shop making use of the outside service cannot afford to keep a good electrical man on its payroll. By a variation of the small-shop procedure, some large shops maintain one or more electrical men of ability, but make use of the outside shop for motor rewinding and major repair.

Presumably the maintenance of buildings can be carried on under the same plan. The separate service organization could inspect and repair the buildings of a group of plants.

More difficult, but conceivably possible, would be the handling of the maintenance of mechanical equipment.

To offset the advantages of the service shops or organizations are the disadvantages of not being certain of getting service the instant it is needed; of a lack of the intimate knowledge of equipment to be gained by men living with it constantly; of losing the personal devotion that the individual will have for his plant when that plant is the only one with which he has to do. The large plant cannot afford to risk having its emergencies occur along with the emergencies of other plants depending upon the same service organization.

That proposals to pool indirect activities are being advanced is significant of the appreciation of the importance of such activities. Leading maintenance engineers will investigate the possibilities in their plants, either as offensive or defensive moves, rather than wait for surprise decisions from the front office. They will make recommendations in accordance with their interpretation of the facts and will refrain from prejudice in allowing the procedure to work itself out economically.

OPPOSITION to machinery and to the progress of civilization has always been in evidence. The files of old newspapers are filled with interesting bits of ridicule and satire. For example, when Jonathan Hulls patented his steamboat in England in 1786, this appeared:

> Jonathan Hulls,
> With his patent sculls,
> Invented a machine
> To go against wind and stream.
> But he being an ass,
> Couldn't bring it to pass,
> And so was ashamed to be seen.

At the time of the invention of the sewing machine, prayers were offered and Heaven implored to prevent the development of this new apparatus which would deprive seamstresses of their living.

From the July issue of *The Kaleidoscope*, publication of Kantack and Company, Inc.

AROUND the WORKS

A section devoted to short articles describing practical methods devised to meet specific operating conditions. The items may refer to details of installation, inspection and testing for maintenance, wiring, repair, and replacement.

Factory Operation Improved by Good Illumination

A FACTORY in which the ideal as set forth in the original design was to obtain maximum daylight in the interior of the building is shown in part in the accompanying illustration. One notices the absence of line shafting, the group-drive motors with the heavy belting, pulleys, hangers and all that goes with that type of equipment.

Each machine is driven by an individual motor in the building illustrated below.

Instead of being suspended from the ceiling and obstructing the light the dust collecting system is located on the exterior of the building.

Daylight illumination was of first importance in planning this building, and as a result all supplemental equipment such as dust collecting ducts were installed on the exterior.

We have been able to illuminate this building artificially through the installation of 100- and 200-watt lights, using RLM reflectors which are set about 10 ft. above the working plane to furnish sufficient intensity to illuminate the work in machine for the operator. We use individual illumination in specific instances such as in the cutting room or stitching department where from 15 to 30 foot-candles are required. It has been found that good illumination pays in a reduction of damaged goods in process.

To supplement the natural illumination the factory is painted throughout with a high-reflecting mill white which has the tendency to improve daylight conditions and reduce the power cost for artificial light.

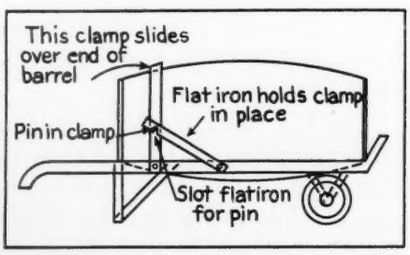
Power junction boxes have been spaced at intervals of 10 ft. so that circuits can be brought out or changed at will as machinery is changed to obtain maximum daylight illumination at the point of operation. Suspending the RLM reflector from the conduit saved fittings and labor. These items were given careful consideration for maximum results, also intensive tests were made to determine the advisability of this type of design.

K. D. HAMILTON.
Mechanical Department
Geo. E. Keith Company
Campello, Brockton, Mass.

Safety Brace Increases Barrel Truck Utility

A SAFE barrel truck or skid can be made from a two-wheel truck as illustrated. Place a clamp on the sides of truck so that it will be about 8 in. back from end of barrel, also bolt a piece of flat iron on the side of truck 14 in. from center of clamp. Then cut a notch in this piece where it slides over the pin which is placed in the clamp.

This clamp extends from one side of truck to the other fitting close to barrel. When taking a barrel from the truck, drop the flat iron from the pin, then back the clamp from the barrel. This truck can be used to haul barrels as well as using it as a barrel stand for oil.



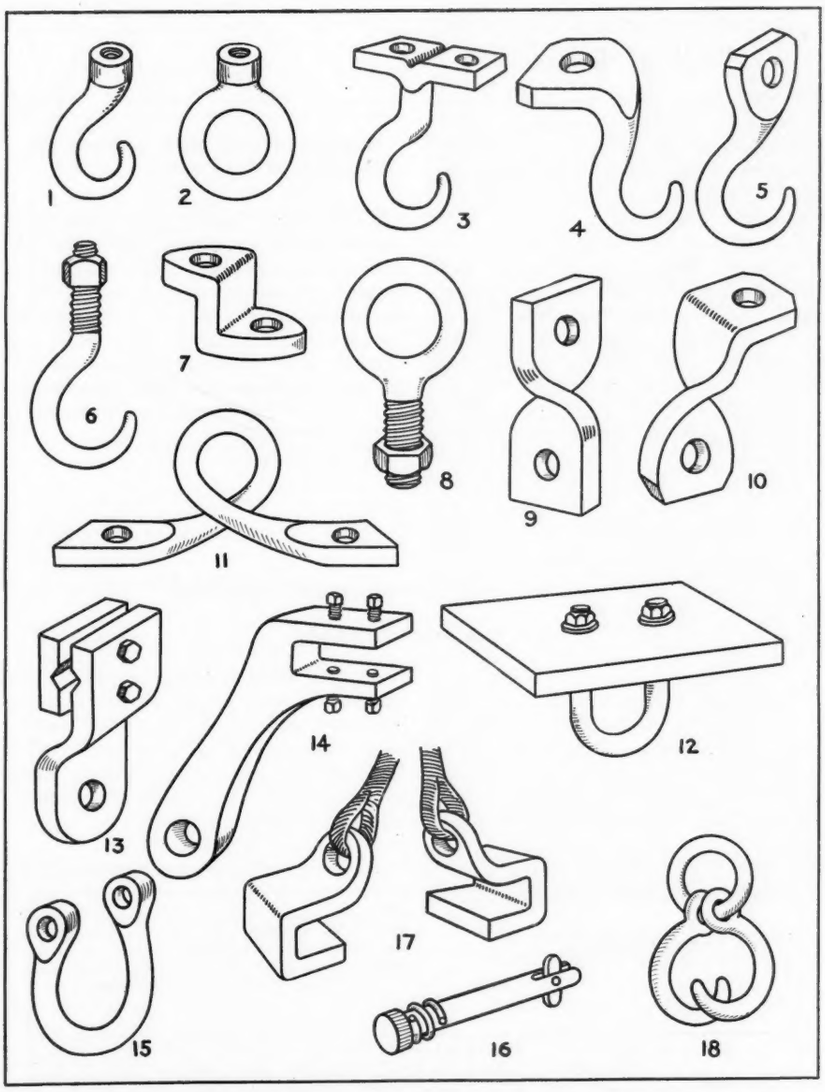
Sliding the clamp over the barrel and locking it in place makes the transportation of oil safer.

Denver, Colo. R. M. THOMAS.

Time-Saving Appliances for the Shop Tackle Chest

IN many plants the tasks of equipment erection and building reconstruction often become the lot of the maintenance group. Work of this character represents no hardships to the group if properly manned with experienced riggers, but without them the handy man about the plant must assume the responsibility for all manner of slings, rigging of tackle, and maneuvering skids.

One thing is evident from observing experienced riggers at work and that



is the ease with which they place their gear in seemingly difficult spots. The desired strap, hook, clamp, or fixture into which the hoisting hook, chain, or cable is placed is always available and quickly placed. Without these appliances the experienced rigger would be in the same position as the handy man, and for the most part they are made in various sizes and of sufficient quantity to save valuable time on such work.

To acquaint those less familiar with the riggers' tools in trade several types and modifications are shown in the accompanying sketches. Practically all are of original shop design and can be made by the plant force.

1. Female hook for attaching to studded parts or bolts for the cable or sling.
2. Female eye ring to take hoisting hooks or hooked slings.
3. Double-eared hook for lag screwing or bolting to beams.
4. Offset flanged hook for bolting on cylinder rims or edges of parts.
5. Flanged hook for direct lifts.
6. Threaded male hook bolt.
7. Stepped strap for offset work.
8. Common threaded eye bolt.
9. Quarter-turn strap with holes in line.
10. Half-turn, 90-deg. strap.
11. Eye strap for special handling.
12. Common U bolt used with a plate.
13. Beam or truss-rod clamp.
14. Clamp hanger with set-screw binders.
15. Clevis or shackle.
16. Safety locking pin for clevis.
17. Prepared slings complete with hooks for special purposes.
18. Sister hooks for slings.

Concord, N. H. C. H. WILLEY.

■

Sulphurous Acid Corrosion in Compressor Lines

DURING the cooling, between compressor stages, of petroleum-bearing natural gas, water and oil were released or "knocked down" from the gas and deposited on the inner surface of the gas pipes. This released liquid contained a varying amount of sulphurous acid which deteriorated the pipes so rapidly that steel pipe corroded through in 90 days and brass pipe in 60 days.

No metal could be found guaranteed to satisfactorily resist this corrosion, cast iron being eliminated because of the high gas discharge pressure—about 500 lb. per sq. inch.

Finally the following expedient was resorted to: All brass was eliminated from valves, unions, and other fittings. Whenever a compressor was shut down, usually about once a month, sufficient low-grade lubricating oil was poured into the gas discharge lines to distribute a film of oil over the interior surface of all pipes and fittings. The compressor was then started and run slowly, until the oil was spread over all surfaces in contact with the gas.

To facilitate operation, an oiler was made from a piece of 4-in. pipe, 24 in. long, closed at the ends. A plug and vent were fitted on the top, and a length of ½-in. pipe containing a needle valve on the bottom. Removing the plug-cap and opening the vent permitted rapid filling. After connecting the oiler, with the plug and vent closed, to a short line leading into the gas discharge line, the needle valve was opened a sufficient amount to cause a fine drip of oil to be carried along with the flow of gas in the line.

During the time that this method of protection has been in operation, about eighteen months, the piping has shown no signs of corrosion. The use of the gas is such that the presence of oil in it has no material consequence.

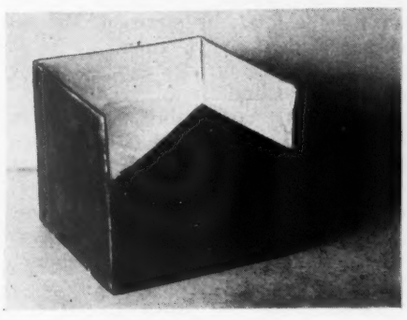
Arcadia, Calif. M. C. COCKSHOTT.

■

Double-Mouth Babbitt Ladle

HAVING a large batch of bearing caps to babbitt, I cut the babbitting time almost in half by placing two caps side by side and pouring them simultaneously by means of a double-mouth ladle. The common single-mouth ladle could, of course, be used to babbitt one cap and then the other, but, beside the disadvantage of a longer pouring time, the metal is cooling off while the first cap is being poured, often resulting in the babbitt being too cold to pour the second cap.

To provide myself with such a ladle,



I cut out one side of a square can, notched out two mouths on one side, and brazed a handle on the opposite side as illustrated. As usual, the babbitt is melted in a pot, and removed by dipping the ladle into the molten metal.

WILLIAM H. MOORE.
Hamilton, Ont., Canada.

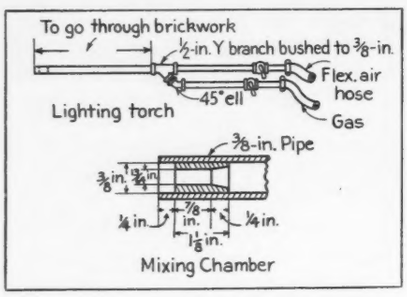
■

Safe Gas Lighters for Gas or Oil Furnace Burners

FAILURE of the conventional lighting torches to withstand the rush of air or to burn long enough to ignite the gases caused considerable difficulty in lighting the burners of gas- and oil-fired furnaces.

These torches, consisting of pieces of kerosene-soaked waste or asbestos rope soaked in kerosene, were set aflame and pushed through the lighting holes, however, in such furnaces the atmosphere is sometimes deficient in oxygen to support combustion, and torches as described caused delays, and were dangerous in that they failed to burn.

To obviate the practice of filling the



Details of torch and its mixing chamber which is turned from machine steel.

furnaces with gas and causing more or less dangerous explosions, the following system was evolved.

Main gas and air lines were tapped to provide service pipe lines to the furnace with branches on both sides and stop cocks fitted at terminals near the lighting holes.

Lighting torches were then made up as shown in sketch, one or more to a side as required, and a pilot light or flame for lighting these in turn was fitted, one on each side. To light the burner the operator adjusts the gas and air for the torch by means of the pet cocks. With the pilot ignited the torch is placed in the furnace before turning on oil or gas and air to burners.

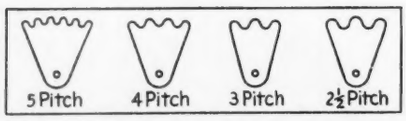
Operators master this procedure quickly, and no time is lost in lighting match after match to have torches blow out, and in addition there is less danger of backfire or explosion. The torches are easily made; the only part requiring care is the little mixing chamber which is turned from machine steel.

Meriden, Conn. JOHN S. ISDALE.

Patterns Facilitate Checking Pitch of Gears

SOME time ago a number of men worked for me, who were not familiar with power drives and they experienced considerable difficulty in checking up on various gears used throughout the plant.

To assist them I conceived the idea of making a pattern covering each gear pitch, making the patterns from sheet metal. Each pattern has three or four teeth correctly shaped, and on the face thereof was stamped the pitch. A set contains a pattern of each of the following pitches: 2, 2½, 3, 4, 5, 6, 8, 10. The set of patterns is strung on a heavy wire ring.



Samples of gear pitch patterns for checking pitch of gears.

When a gear in any part of the plant shows excessive wear, any available workman can easily get full information required to order a new gear by fitting the proper pattern to the gear, counting the teeth, measuring the face, bore, and keyseat. This procedure saves time for the man in charge and eliminates errors.

CHAS. A. PETERSON.
Master Mechanic
Cold Spring Granite Company
Cold Spring, Minn.

■ ■

Preventive Maintenance as Applied to Printing Presses

NOTHING so exasperating in a printing plant as breakdown of a press—possibly after many hours of make-ready. Monthly inspection of the presses, if it is the right kind, will forestall failure—is really preventive maintenance. The Meredith Publishing Company, Des Moines, Iowa, carries on that kind of inspection and insists that the pressman and mechanic go on record over their signatures. The form used is illustrated — can be applied in other printing plants as is, in other industries after alterations.

Press Inspection Sheet

Date _____
Name & No. of Press _____
Date Press should be repaired _____
Signed _____
(Superintendent of Press Room)

	Col. I	Col. II		Col. I	Col. II
Cyl. Gears			Feeder Pumps		
Cyl. Bearings			Ink Tables		
Cyl. Bearers			Misc. Gears		
Cyl. Stops			Feeder		
Switch Frames			Feeder Drive		
Bed Motion Roller			Angle Roller Belt		
Switch Frame Shoes			Guards		
Switch Cams			Gibs		
Bed Motion Rack			Delivery Cyl.		
Slider Bar Rack			Delivery Parts		
Slider Rack Gear			Feed Boards		
Slider Carriage Roller Track			Running Boards		
Air. Cyl. & Leathers			Railings		
Governor Valve			Lights		
Gripper Tumbler Opening Pin			Attachments		
Gripper Tumbler Closing Pin			Oiling System		
Segment Rack			Roller Sockets		
Segment Gear			Tye Reels		
Roller Rack			Broken Castings		
Roller Gears					
Drive Belt			Suggestions from Pressman		
Drive Chain					
Ink Fountains					

Signed By _____ Date _____
Pressman

_____ Date _____
Mechanic

Pressman will check column I for each part needing repairs and write on the back what repairs are needed and report any items not listed.

Mechanic will check each item on sheet and mark O.K. when it is found O.K. or repaired.

A. G. BAUMGARTNER
Industrial Engineering Department
General Electric Company
Schenectady, N. Y.

Electrical instruments present facts — keep records — and nullify alibies.

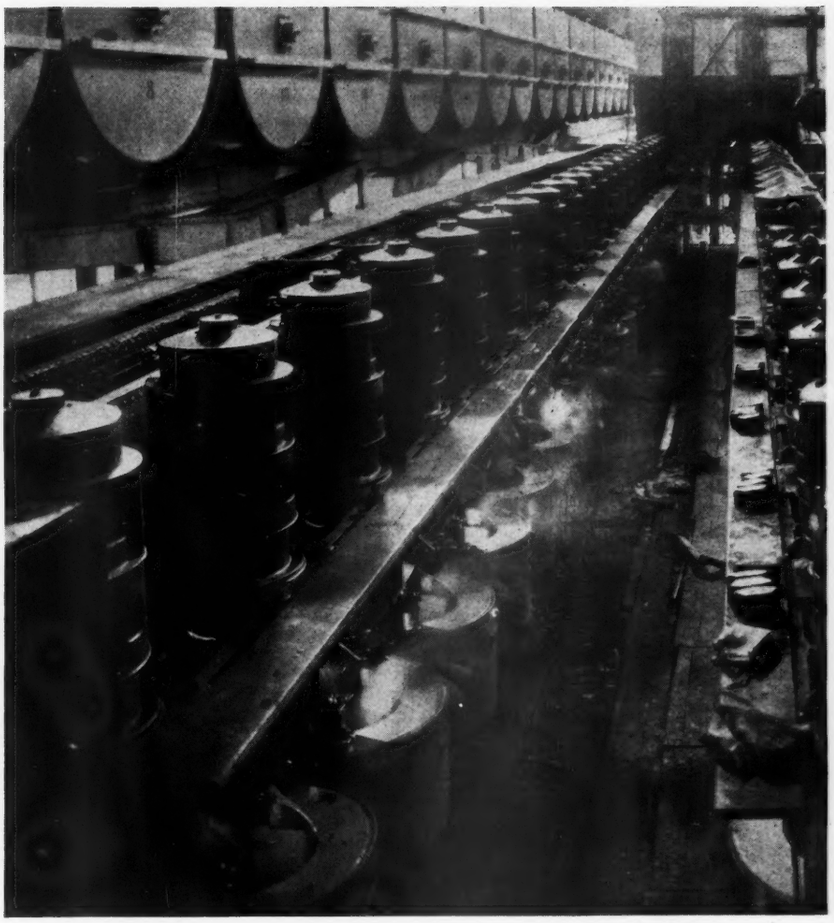


Fig. 1—Sugar centrifugals impose on the driving motor complex load characteristics that require careful study.

"YARDSTICKING" POWER CONSUMPTION

PRESENT-DAY industry is characterized by ever-higher standards of precision, complexity of methods and materials, severe competition, and large production. It is almost axiomatic that small profits attend production in large quantities. In order to increase this narrow margin of profit, it is essential that careful attention be given to the production processes.

Industry has today quite generally come to depend upon electrical energy as its source of power. This form of energy readily lends itself to measurement. Instruments for measuring electricity may be classed as indicating and recording. Both these classes may again be divided into portable and non-portable types. The non-portable type of instrument is usually permanently connected in a power circuit. A typical application of this type of instrument is found in switchboard-mounted instruments that indicate or record the total power for a plant.

The portable type, as the name indicates, can be carried about and attached to different circuits at will.

The indicating type of instrument gives the momentary value of the quantity that it is measuring. Such instruments are generally used for loads that remain fairly constant. The damping of this type of instrument, coupled with the physical inability of the eye to follow the needle, precludes its use on rapidly fluctuating loads. The value of the meter in such cases lies in its ability to indicate the presence of the fluctuations. A typical use for indicating instruments is in measuring the fixed voltage of a power source. Another use is to measure the current drawn by a motor that is operating under a more or less constant load.

A recording instrument may in general be described as an indicating instrument that is equipped with a

pen instead of a needle. The pen traces a record of the variations in the factors which it is designed to measure. A popular form of record is that in which the record roll is arranged to unwind from a spool, pass under the pen where it receives the record, and then be rewound on another spool.

The portable type of recording instrument is especially valuable in analyzing production methods. It may be placed anywhere and requires no attendant. For example, one instrument using a 60-ft. record roll can be adjusted to give a chart speed ranging from 12 in. a minute to 1 in. an hour. Thus, it can function unattended for periods varying from one hour to three or four weeks. After the instrument has been in operation for a prescribed interval, a permanent record of its unbiased analysis of the problem can be given a thorough examination.

A few examples of the uses to which these instruments are put will serve to illustrate some of their possibilities. Power bill investigations are a popular application of the recording instrument. Power companies quite generally use the peak load of an industrial plant as a basis for fixing the rate. A recording instrument can often effect real savings in the power bill by breaking down and analyzing the components that go to make up the peak. Such an analysis may suggest the advisability of alternating the schedules of large power-consuming machines, instead of super-imposing them and thereby causing high power peaks.

In one instance, a rubber manufacturer realized a saving of more than $1,000 a year as a result of better load conditions and reduced overtime operation by means of an analysis with a recording instrument.

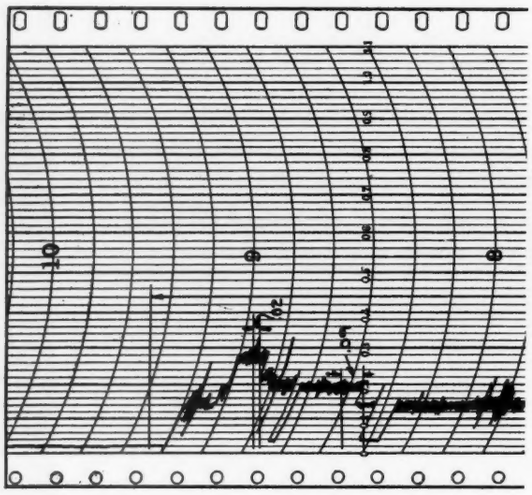


Fig. 3—Study of the operating record of an electric furnace led to changes that resulted in a saving of $50 a day.

Power factor studies are another application of electrical instruments. Frequently a study will show that synchronous motors can be employed instead of induction motors. Synchronous motors can readily be designed to improve the power factor in a plant. In one particular case the power factor was increased from 75 per cent to 95 per cent following a survey with a recording instrument. A direct saving of about $100 a month resulted.

It may not always be realized that a recording instrument can be used to study the efficiency of a machine, or an entire plant. The length of time required for a plant to attain the normal morning and afternoon production is clearly indicated on the record of a graphic instrument. The same statement applies to segregated portions of the plant, and even to the individual machines. Fatigue studies can be carried out in similar fashion.

The Accounting Department can employ the reliable records of a recording instrument on a battery of machine tools to determine their active and idle periods, or improper use. For profitable production the investment represented by modern machines cannot be left idle.

The graphic instrument can be of great assistance in the design of new machines. For example, centrifugal extractors present problems of acceleration and varying loads. Proper motorizing can result only from a thorough knowledge of the load cycle, based on recording-instrument curves.

The design of planer equipment has been and is still being based on records obtained with recording instruments. Motorization of punch presses has been revolutionized on the basis of evidence furnished by graphic meters. Timing of automatic machines can be improved by a study and proper interpretation of the variations occurring in a record. Every reversal, every traversing and index-

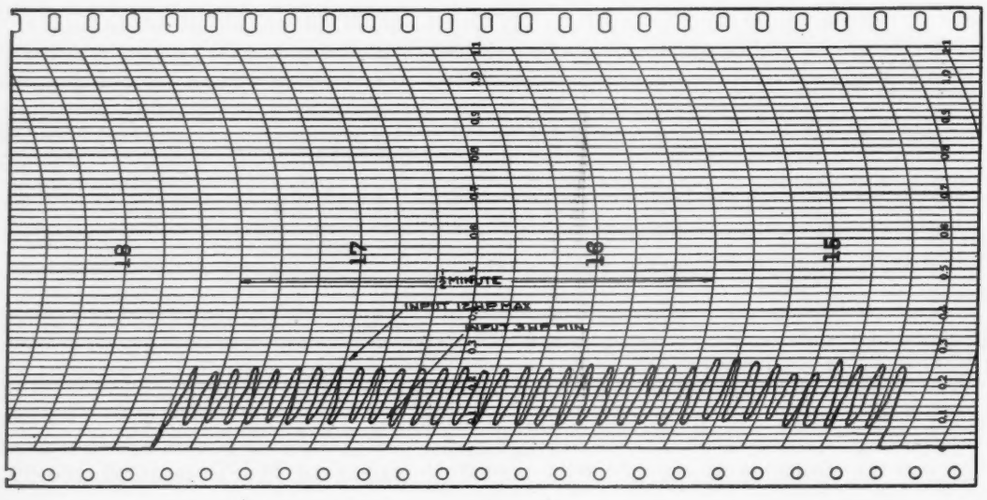
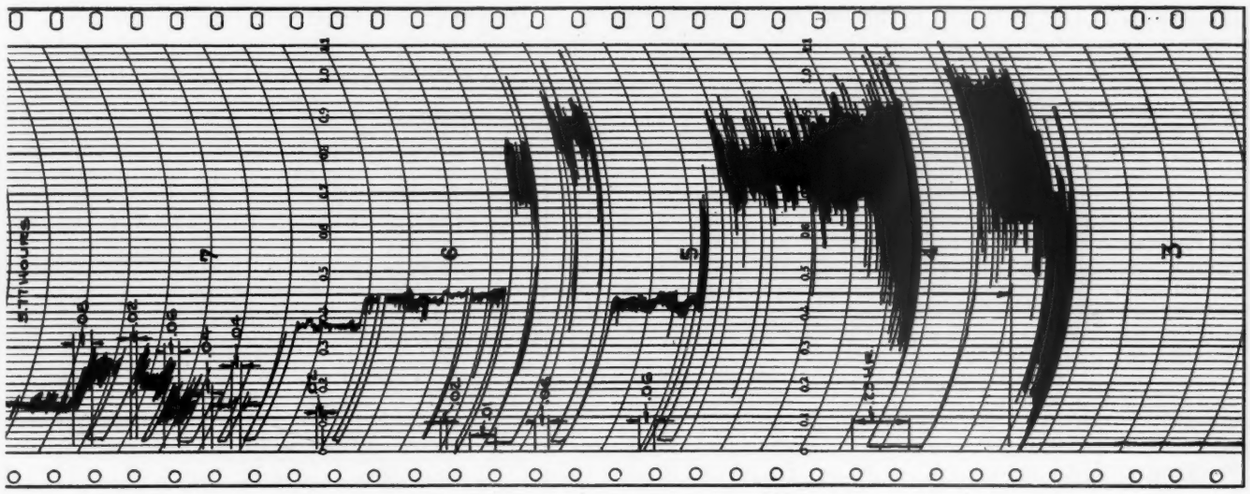


Fig. 2—The graphic instrument records obtained from a test on a rotary digester showed abnormal load peaks that were later traced to mechanical faults in the digester.



ing operation—in brief, each movement of the machine is included in the record furnished by one of these instruments.

An example of the desirability of checking industrial operations—which also shows that such checks need not be confined to machines already in service—is given by the record shown in Fig. 2. This record was taken on a rotary digester before final installation. The power required was supposed to be about 3 hp. The instrument record shown indicated 41 peaks a minute, each attaining a value of about 12 hp. Defects in the machine were suspected, and investigation disclosed bearings out of line and a sprung shaft. Delays in production and other losses were thus easily prevented.

The same instrument was used to test a molasses pump. Its record showed the average and maximum power input, and the strokes per minute. A short drop in input for several strokes indicated failure of the cylinders to fill with molasses, and provided data for correcting this condition.

In Fig. 3 is shown a record of the investigation of an electric furnace. The regulation of this furnace was thought to be correct. However, the graph from a recording instrument showed possibilities of real improvement. The record indicated that during a 5.77-hr. heat, the power was off 13 times for periods of 0.02 to 0.23 hr. each. The total time loss was about 0.55 hr., or 9.5 per cent of the time of the entire heat. A total saving of two hours per furnace, which resulted from this study, was conservatively valued at about $50 a day.

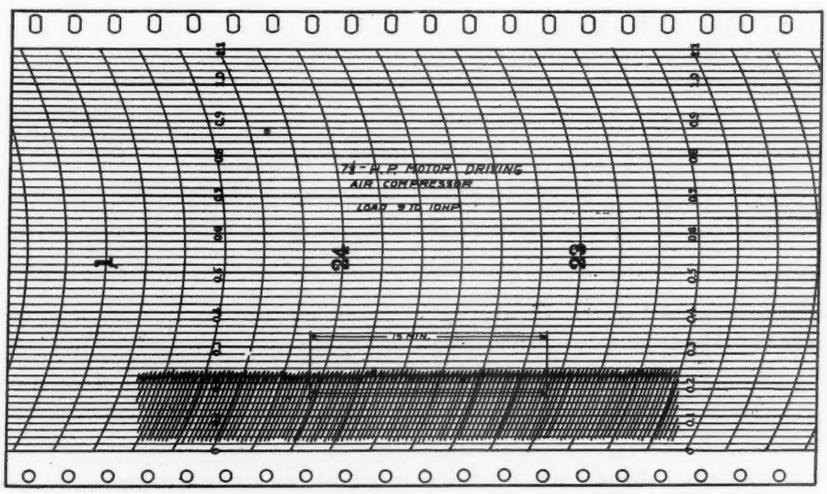


Fig. 4—A check with a recording instrument disclosed a 25 per cent overload on the 7½-hp. motor driving a compressor. Reducing the speed of the compressor removed the overload and saved power.

Continued heating of a 7½-hp. compressor motor indicated that it was overloaded. A test with a recording instrument showed the average load was 9 to 10 hp., representing an overload of about 25 per cent. This record is shown in Fig. 4. The condition was remedied by changing a pulley to reduce the compressor speed, inasmuch as the analysis showed that the process required less air than was being furnished.

A rubber company kept a main transformer bank on the line during the 36-hr. week-end period to supply a 2-hp. motor that operated continuously. A recording instrument showed the week-end load, including transformer losses, was 9 kw. when only the 2-hp. motor was running light. Consequently, a 1½-hp. motor connected to the lighting circuit was substituted for the other, and the large transformers were shut down. A reduction of 15,715 kw-hr. consumption at a saving of $314.30 was effected.

The records also showed that power was being wasted through unnecessary use of the elevators, and a study of elevator operation during working hours resulted in changes that saved 10 per cent in power costs.

The production department of a refinery suspected that there was faulty operation on the part of its flow meters. Readings did not agree with the total flow as determined by other methods. So long as the accuracy was in doubt, the $7,000 investment in flow meters was a loss. By means of a recording meter the source of the trouble was traced and found to be due to fluctuations in line voltage. A voltage regulator overcame that condition.

Counterbalancing pumping equip-

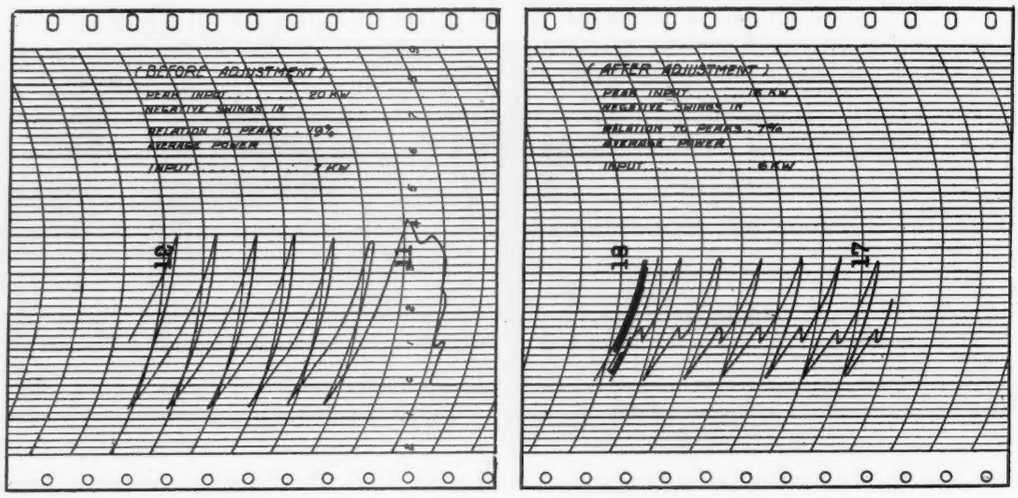


Fig. 5—Power consumption was lowered and load peaks of an oil well pumping rig were greatly reduced through the data supplied by a graphic record.

ment is a necessity in the oil field as a means of conserving power and of reducing strain and shocks on pumping rigs. Recording instruments are of material assistance in solving such problems. An example of this type of application of the instrument is shown by the comparison given in Fig. 5. Before adjustment of the pumping equipment there was a peak input of 20 kw. Negative swings in relation to peaks were 19 per cent. The average power input was 7 kw. After adjustment the peaks dropped to 16 kw., the negative swings were reduced to 7 per cent in relation to peaks, and there was a reduction to 6 kw. average input.

Measurement by a recording instrument furnishes a positive basis upon which to form decisions. The human element is removed from this type of analysis, and impartial evidence is presented.

Lighting Facts

W. STURROCK
Illuminating Engineer
Nela Park, Cleveland

Presented at the second Annual Conference of Electrical Maintenance Engineers, Akron, Ohio, June 4 and 5, 1931

■

THE eye is capable of adapting itself to see under illumination which ranges from a small fraction of a foot-candle to several thousand foot-candles. Under very low illumination the eye does not receive sufficient light to enable it to distinguish color or detail and under unusually brilliant sunlight a blinding effect obliterates detail. Between these limits there is a wide range where good vision is possible.

Under present accepted standards, excellent lighting for industrial plants would be 25 to 50 foot-candles.

If the illumination is safeguarded as regards quality, that is, well diffused and with no extreme brightness contrasts between the work surfaces and the surroundings, it is difficult, indeed, to provide too much light for the eye. On the other hand, considerations of economy usually limit the level to the lower values.

Complete tables of recommended standards of illumination have been established by experience in modern practice and are available from the lighting equipment and lamp manufacturers.

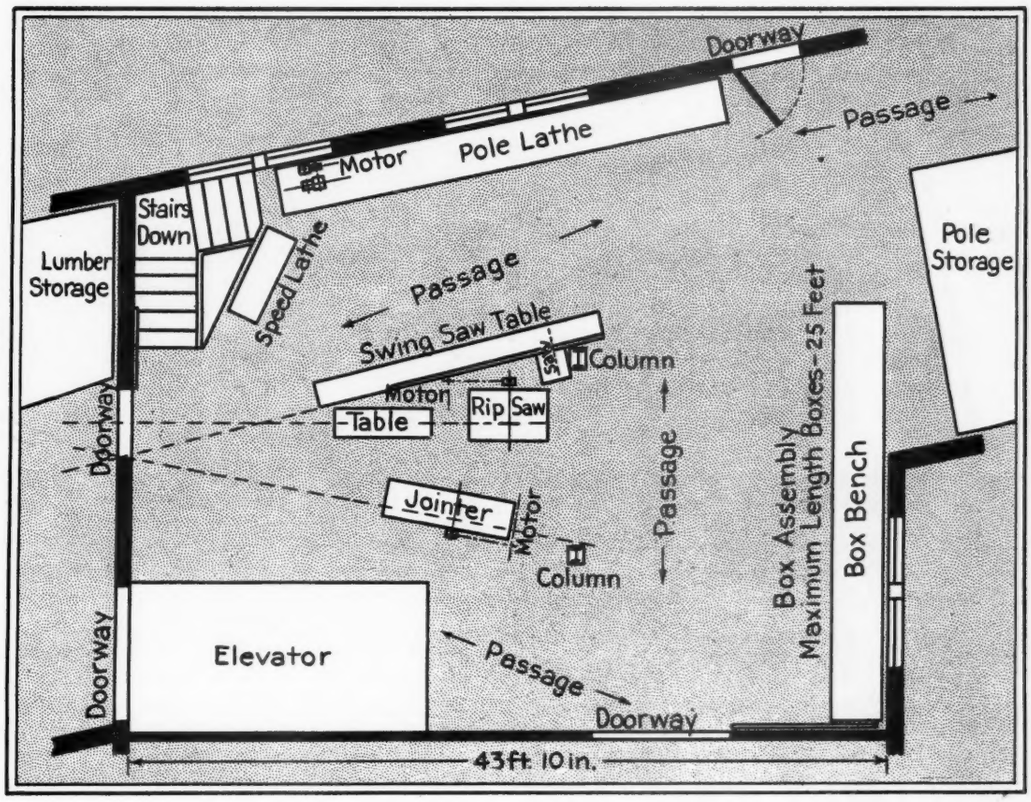
Many of you who have worked on lighting problems for the past ten to fifteen years have noticed that the illumination levels used for various classes of work have practically doubled. You may, therefore, be wondering just why the worker demands more light today than he did a few years ago.

The answer to this question is that experience has shown such a definite value for better light that it is rapidly becoming general knowledge throughout the industry. A few years ago no one realized that lighting played so important a part in reducing the cost of production or eliminating accidents and fire hazards. Furthermore, ten to fifteen years ago manufacturers did not have entirely satisfactory lighting units which would control and diffuse the light in such a manner that high levels could be used in general factory areas.

From tests made in the laboratories on lighting, a great deal of knowledge has been obtained on the value of higher illumination levels far in excess of those which are at present considered economical. Investigations show that there is a definite advantage in using 20 foot-candles instead of 10, or in using 50 foot-candles instead of 25.

Due to the use of some of these higher levels of illumination there is a definite trend toward supplementing good general illumination with high intensity local lighting at particular locations where 100 or more foot-candles are desired. For example, for fine assembly work or close machine work where a high intensity of light must be directed to some particular point, a concentrating type of reflector employing a 50 or 200-watt lamp might be used by locating it near the ceiling and out of the way.

This high intensity spotlighting is coming more and more into general use for the lighting of vertical surfaces along assembly lines and for lighting underneath overhanging parts on large machines and similar places where it would be difficult to provide a high intensity of illumination from the general lighting system.



Layout of the shop to facilitate the handling of long boxes in the process of fabrication.

Same Space, New Layout— and small shop is bigger

WALTER C. SUTTON
Plant Engineer
The Lindsay Wire Weaving Company
Cleveland, Ohio

■ ■

When the small shop has to increase its output and efficiency, space remaining the same, there MUST be a way to do it. The author found it in the re-arrangement of equipment when electric supplanted steam drive.

MANY restrictions are imposed on the small shop in the plant that is entirely dependent upon steam as a source of operating power. Oftentimes, as a result, complicated drives prevent layout of equipment that will be sufficiently flexible to accommodate any necessary change in the product. Such was our problem, the solution of which is offered to those similarly situated.

The floor plan shown is that of a shop in which are made the poles and boxes used for shipping paper-machine wire cloth. The shop was laid out many years ago, when power was supplied by a steam engine through a lineshaft hung on the two columns indicated. Of necessity, all machines were placed parallel to this lineshaft, and the usual arrangement of countershafts, hangers, and belts covered the ceiling. When electric power supplanted steam, separate 5-hp. motors were used to drive the lineshaft, and the countershaft of the pole lathe.

Since the original layout, paper machines have increased in width until wire cloth is now made as wide as 23 ft., requiring shipping boxes up to 25 ft. in length. It became impossible to finish the longest boards without reversing them and, in addition, more power was required at the machines. A new location or arrangement for the shop was imperative.

Because no better location was available it was decided to rearrange the machines, and change to individual motor drive. The problem was

complicated by the presence of a stairway and an elevator, and by the odd shape of the available space. The floor plan shown was worked out to leave the necessary clear passageways for moving the long boxes, and to permit the sawing and planing of boards 25 ft. long.

Individual drives permitted placing the saws and jointer in the positions shown, so that long boards could be fed through the door from the lumber storage room. By placing the motors on the floor, boards can be transferred readily from swing-saw table to jointer to rip saw, and back for the final pass through the jointer, without interference with the belt drives. Although using a common aisle, the rip saw and jointer run in opposite directions, thus saving two passes of each board.

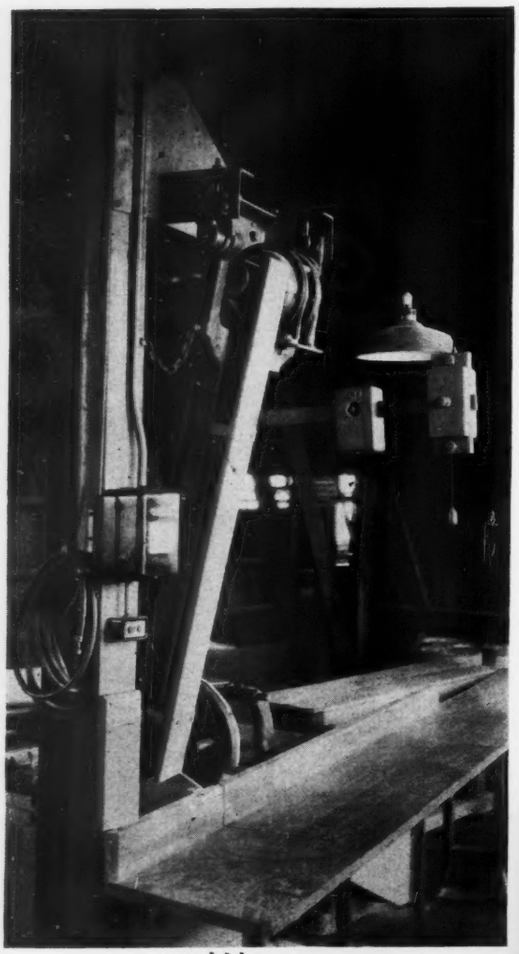
Boxes are assembled on the bench and on horses in the assembly space. Complete boxes are in position to go through the door, shown at the bottom of the plan, to the finishing department where the wire cloth is packed. The box returns through the shop and out the passage, at the right, to the shipping room.

Omitting the pole-lathe countershaft, the cone of the lathe was belted directly to a two-step cone on the motor shaft. The 5-hp. lathe motor is mounted vertically on an angle-steel frame bolted to the wall back of the lathe, and is controlled by a shipper-operated master switch. The lathe spindle was extended to carry the feed-drive cone formerly on the countershaft, and a ball-thrust bearing back of the pulley in the headstock was substituted for the plain thrust bearing originally at the end of the spindle.

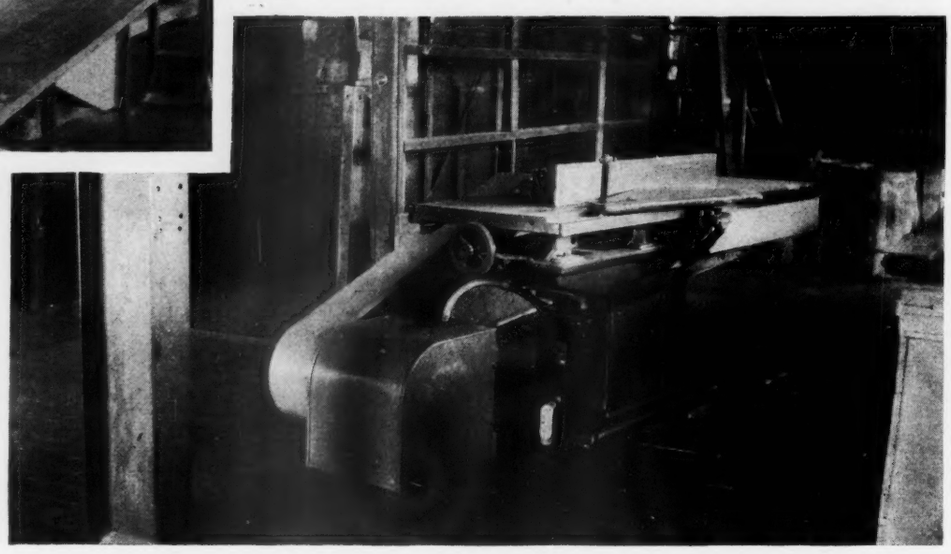
By removing the loose pulley shaft, and mounting a 3-hp. motor on angle brackets in the fork of the swing frame, the swing saw was converted to an individual drive. The original, adjustable swing bearings were mounted in a welded, angle-steel frame which was bolted to a 1¼-in. steel-plate bracket hung on the column, as shown in an accompanying illustration. The plate bracket was adjusted and steadied by a 1½-in. pipe brace to the other column. Eccentric loading of the near column is prevented by a rod (not shown) from the end of the bracket to a roof beam. The saw table was reversed to be "left handed" as compared with the customary position; however, after a few days' use no inconvenience was noticed.

Both rip saw and jointer are similarly driven through mineral-tanned belts by means of 5-hp. motors mounted on the floor back of the machines. Dust-proof, sheet-metal covers protect the motors, which are readily removable for blowing and oiling. A pushbutton station at each end of the jointer table saves steps in starting and stopping the motor. Only one pushbutton station is used on the shorter rip-saw table. An illustration is included to show the jointer drive.

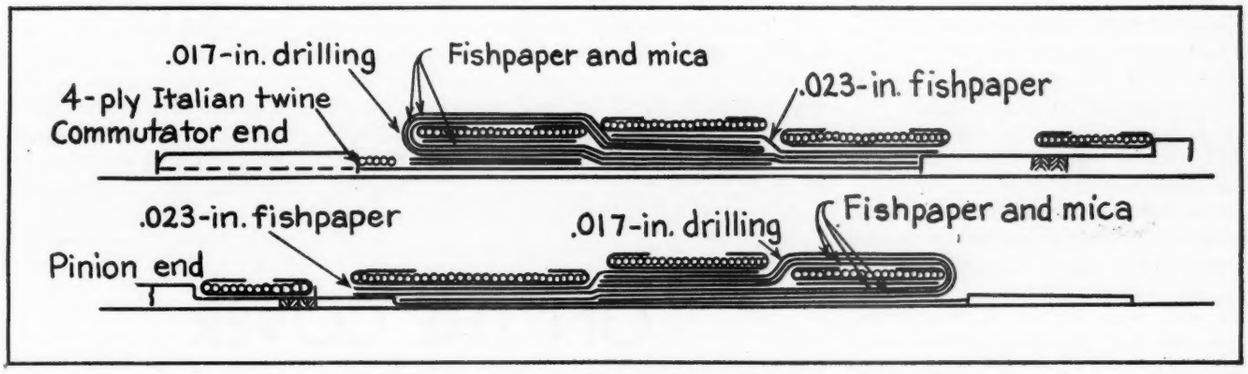
With this arrangement, labor is saved and light and appearance improved, the total cost of which was very moderate.



One of the tools changed to individual drive. Its motor was mounted on angle brackets in the fork of the swing frame.



Dust-proof steel covers protect the floor-mounted motors which are controlled from the tables by means of pushbuttons.



Method of insulating a three-section, single-layer band for an a.c. rotor.

Core-Band Insulation for D.C. and A.C. Rotors

A. C. ROE

Renewal Parts Engineering Department
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

INSULATION applied under the core, or end, steel-wire bands used to retain the windings of wound d.c. and a.c. rotors, is selected for its known characteristics and the ability to meet conditions existing on various types of rotors and armatures.

The function of this band insulation is:

1. To introduce a barrier between the steel wire and the conductors of the armature coil of sufficient thickness and width to prevent conductance or creep of current from the coil or coils to the band or core.

2. To provide a level and true-circle bed for the banding wire that will compress and retain the winding as a solid and compact structure under operating conditions, for long periods of time.

Band insulation will vary in type, combination of materials, widths, thickness, and so on, according to the type of machine, operating voltage, speed, and diameter of the rotor or armature. It is the purpose of this article to discuss the general practice in insulating running bands. Segmental band insulation will be discussed in a later article.

Core-Band Insulation

There are various combinations used for retaining the windings in the slots, and the insulation under the core bands depends upon the operating voltage, insulation on the coils, and the banding surface, as follows:

Surface core bands are applied directly on top of the coils, and thus pull the winding or coils down flush with the surface of the core. In these cases the airgap limits the size of wire and thickness of insulation that can be used; hence, the insulation on the coil is important. If it is ample, a single layer of fishpaper can be used under the band to prevent the band from cutting into the coils, and to insulate the bands from the core. If there is any doubt about the adequacy of this insulation, use one or two layers of fishpaper and mica under the bands.

Grooved Core Bands and Wedges—The majority of mill-type, mining, crane, and railway motor armatures have band grooves cut into the core, and some of the armature coils used in these motors have a strip of fishpaper or micarta taped in on top of the top half of each coil. Therefore, any insulating material under the core bands is used to reduce eddy-current heating. When the strip of insulating material is not included in the coil, a strip of fishpaper is used under the core band to protect the coil.

Where the insulating strips are used on the coils, a strip of tinned sheet steel is placed under the core bands and against the core. To reduce eddy-current heating, a strip of asbestos tape is placed between the tinned strip and the core.

When the core bands are applied in two or more sections, asbestos tape is used to separate the sections.

The use of tinned sheet steel under the core bands results in a tight, solid band of great strength. When taking rewinding data, check the core bands carefully to determine whether they are single or in sections, material used under the bands and against the core, and so on.

The prime requisite for a good end band is a tight, true, concentric circle of coil ends, leveled off with a few turns of tape to eliminate low spots. It is important that the bands rest on and exert pressure on each coil end; that is, all coil ends must have the same diameter.

On the general run of d.c. armatures the end bands are put on in one single wide band of one or more layers. On a.c. rotors the bands on the coil ends are in a great many cases divided into two or more sections insulated from each other. Diagrams *A* and *B* in the illustration show one method of insulating a three-section, single-layer band for an a.c. rotor. Note that the outer section of the front and rear bands is inclosed in a hood of drilling and two layers of mica and fishpaper.

There are three general types of end-band insulation used on the majority of armatures. However, there are exceptions to these general types, and care should be taken when stripping an armature to observe the type of end-band insulation used.

Method 1—Apply two layers of treated fullerboard. Apply shellac between layers and hold them in place temporarily with a few turns of twine.

Method 2—Apply two layers of untreated surgical tape and two layers of treated rope cement paper between the layers of tape. Saturate the tape well with shellac. Use standard widths of tape when possible.

Method 3—(For class B insulation). Apply two layers of fishpaper and one layer of asbestos tape. Apply the mica so that the fishpaper is against the coils and bands, and the asbestos tape is between the band, and the mica and fishpaper strips. Use standard widths of tape, slightly overlapping the edges when it is necessary to use more than one turn to cover the band width.

End-band insulation should be cut wide enough to extend at least ¼ in. on either side of the steel bands.

Bands Over Commutator Necks or Leads

These bands are incased in a hood of drilling. The drilling is cut wide enough to overlap on top of the steel band, and is placed on the bottom of the band. Then two layers of untreated surgical tape are applied, with two layers of treated rope cement paper between the layers of tape. The steel band is wound on; then the drilling hood is overlapped on top, and held in place with machine thread approximately 1/32 in. in diameter. Brush the drilling, tape, twine, etc., thoroughly with shellac, to cement all parts together.

Although the information in this article does not cover all types and methods of insulating bands, it is sufficiently broad to enable one to apply properly the materials supplied by the factory on renewal part orders. Data on other methods of insulating bands can be accumulated and recorded by closely examining all armatures stripped for rewinding.

ON THE COVER

is shown the Chicopee Falls, Mass., plant of The Fisk Rubber Company. Devoted exclusively to the manufacture of automobile tires and tubes, this plant occupies an area of 18 acres of ground space and is housed in 18 multi-story buildings of brick, concrete, and steel construction. The total floor area is 1,413,976 square feet.

Power for operating the production machines is supplied by 1,200 three-phase, 60-cycle, 550- and 2,300-volt motors ranging from 1/10- to 500-hp. rating. The total connected load is 19,100 hp. Electrical energy for operating the motors and lighting system is purchased at 13,200 volts and stepped down to the distribution voltage of 550 and 2,300 volts by eighteen 550-kva. transformers. A total of 200 miles of electric wires and cables is required to transmit power to the 1,200 motors, 17 elevators, and 15,000 lights in the plant.

Steam requirements for heating and process work necessitate the operation of five 750-hp. boilers.

Rapid and efficient transportation of large tonnages of raw materials, stock in process, and finished stock, between machines and departments is a highly important link in the production scheme. The backbone of the materials handling system is an extensive installation of chain conveyors. In this system there are 47 separate conveyors traversing various departments at an average speed of 60 ft. per min. The individual chain conveyors range from 27 ft. to 3,000 ft. in length and have a combined length of 12,000 ft. Supplementing these are belt conveyors with a total length of 2,500 ft. and sections of rollers conveyor totaling 1,400 ft. in length.

Maintenance of the conveyor system is, naturally, a matter of such supreme importance to the uninterrupted flow of production that three oilers and inspectors devote their entire time to this equipment. Inspections of all elements of the conveyor system are made daily, and any needed repairs, adjustments, or replacements are made promptly.

Use of flammable liquids and materials in some of the processes introduces a fire hazard that has received careful attention. All buildings are as nearly fireproof as they can be made, and are fully protected by sprinkler systems. In addition, there are numerous hose stations, fire buckets, and extinguishers located at strategic points throughout the plant, with boxes containing fire blankets and extinguishers placed close to individual machines and processes that present an unusual hazard.

Further safeguarding the entire plant is a fire department of 23 men under the direction of an experienced fire chief, who devotes all of his time to this work.

Maintenance of the plant equipment and buildings requires a well-organized department of 122 men working under the supervision of the mechanical superintendent, who reports to the factory superintendent. The maintenance department is amply provided with both men and facilities for handling any work which it may be called on to do. A well-equipped electrical department and repair shop handles all electrical installation and other work, except motor rewinding. Practically all installation and repair work of a mechanical nature is handled by the mechanical department, which has available all of the machine tools and other equipment needed, including gas and electric welding outfits.

Building maintenance is under the direction of the mechanical superintendent who, with his force of carpenters, painters, and other tradesmen, sees to it that all structures are kept painted, floors, roofs and other parts repaired and kept in safe condition, and other necessary work done. This division is also responsible for making all building alterations and additions.

BOOKS

Seeing

By M. Luckiesh and Frank K. Moss, both of the Lighting Research Laboratory, General Electric Company, Nela Park, Cleveland, Ohio. The Williams & Wilkins Company, Baltimore, Md. Cloth, 267 pages, 103 illustrations. Price, $5.

WITH the two-fold purpose of conserving vision and increasing productivity, the authors have coordinated two well-known sciences—lighting and vision—into one, which they call seeing.

Inadequate lighting is given a substantial part of the blame for the appalling amount of defective sight existing today as well as for fatigue and inefficiency in industry. The contention that the science of lighting is still in the infancy of its development is supported by the fact that the brightest modern illuminating systems produce only a small fraction of the intensity of sunlight.

The relation and importance of the four variables affecting sight—size, contrast, brightness, and time of exposure—are studied and discussed. Chapters on the pupil of the eye and subnormal vision give a broad general insight into the physical characteristics and care of the eyes.

Of more practicable value to illumination engineers are chapters on characteristics of objects, footcandles, general lighting plus, and costs and values.

■

Electrical Engineering

By Clarence V. Christie, Consulting Engineer, Professor of Electrical Engineering and Head of the Department of Electrical Engineering, McGill University, Montreal, Canada. McGraw-Hill Book Company, Inc., 370 Seventh Ave., New York, N. Y. Fourth edition, cloth binding, 662 pages. Price $5.

PROFESSOR Christie's book, first published in 1913, has become an authority on the fundamentals of electrical engineering, and is used today in many of the leading technical schools and colleges of the country.

A complete exposition of fundamental electrical theories is presented. From the classic conceptions of electrostatics, and electromagnetics and magnetism, the student is led to the consideration of Ohm's Law and simple electric circuits, and then introduced to the more complex alternating-current theory. Principles of electrical design are also explained and discussed. Rigid mathematical proof is given for all steps involved.

Among the additions to the new edition are an outline of the mathematical relations required for the solution of problems in alternating-current theory, the design of a commutating-pole d.c. generator, a discussion of the problems of system stability (which are lately acquiring added importance in the eyes of power engineers as high-tension systems are becoming far-flung, and generating units of varying capacities and characteristics are joined in vast interconnected networks) and a set of typical problems in electrical engineering.

The work assumes on the part of the reader a good knowledge of algebra, trigonometry, and the methods of the Calculus. It is not to be recommended to practical men with limited mathematical training.

■

Engineering Mechanics

By Frank L. Brown, Prof. of Applied Mechanics, University of Kansas. Publisher, John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Cloth, 477 pages, over 500 illustrations. Price $4.

PRIMARILY intended for use as a textbook by students of engineering, this book contains comprehensive amplification and explanation of the fundamental principles of mechanics at the expense of the usual number of applications. However, a few of the instructive applications have been included, together with numerous illustrative and practice problems of both the practical and imaginative types. Answers are given in most cases. Beginners are warned of the more common errors made by those before them.

■

Sanitary Drinking Facilities

A LARGE majority of the drinking fountains in use are capable of transmitting directly from one person to another at least 15 specific diseases, ranging from such serious ailments as tuberculosis and streptococcus infections to the common cold. This statement is contained in the 28-page Bulletin of the Women's Bureau, No. 87, by Marie Correll, issued by the United States Department of Labor.

The investigation forming the basis of this report covered about 1,500 places of employment in 21 states, in a period from 1923 to 1929. Though more than 40 per cent of the establishments studied had fountains for all or some of their employees, less than 15 per cent had any of the type that prevents the direct transmission of infection.

Only about 4 per cent had sanitary fountains available for all their workers.

Three sets of standards for the design and construction of sanitary drinking fountains, those of the American Water Works Association, the United States Public Health Service, and the American Public Health Association, are contained in the bulletin. State laws, regulations, and recommendations pertaining to public drinking facilities are also given and discussed.

■

Pipe Welding

THIS 44-page supplement to The Oxy-Acetylene Welders' Handbook contains information of practical use to the plumber, steamfitter, piping contractor, heating contractor as well as his foremen, supervisors, welding instructors and apprentices.

It discuses equipment needed, types of joints, beveling with torch, spacing, making clamps, tacking, templates, headers, branches, reducers, closures, fittings, tube turns, flanges, bends, and anchors—shows how to design a welded layout and gives qualification tests, costs of pipe welding and cutting. Tables and illustrations make it easy to follow text.

The Bastian-Blessing Company, 244-A, East Ontario St., Chicago, Ill., will send the book free to anyone writing on company stationery.

■

The Design of Capacitor Motors

ENGINEERING Research Bulletin No. 19, "The Design of Capacitor Motors for Best Starting Performance," by Benj. F. Bailey, Prof. of Electrical Engineering, University of Michigan, is the outgrowth of an investigation of single-phase motors started in 1923 and during which the condenser or capacitor motor was developed.

Having been called upon to design a large number of such machines, the author has endeavored to simplify the fundamental theory and the methods of making the necessary computations. That portion of the theory which relates to the locked or starting torque of capacitor motors is presented in its simplified form. Copies are available at $.50 each.

■

Small Universal Motors

"VOLTAGE Regulation and Losses in Small Universal Motors," by Albert F. Puchstein and Ivor S. Campbell, has been issued as Bulletin No. 58 of the Engineering Experiment Station of the Ohio State University. Copies may be obtained by addressing the Station at Columbus, Ohio.

EQUIPMENT NEWS

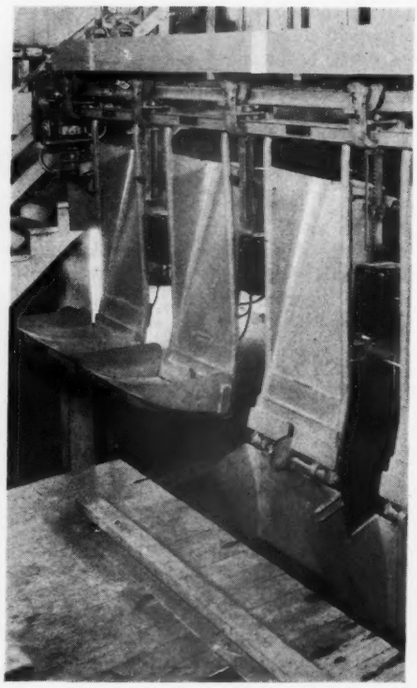
Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs.

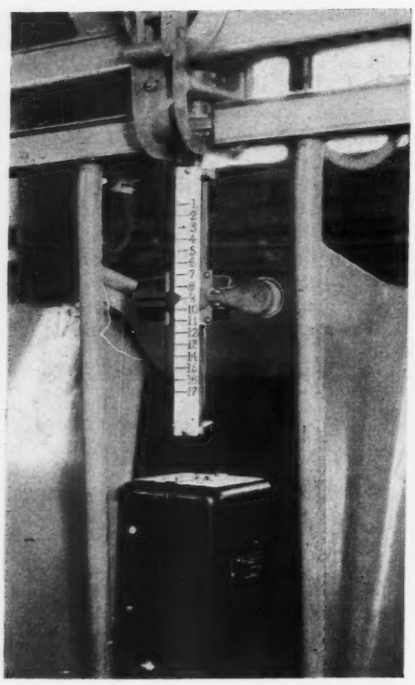
Cleveland Tramrail Photo-Electric Cell Control

PHOTO-ELECTRIC cell control for application to its tramrail systems is announced by the Cleveland Electric Tramrail Division of The Cleveland Crane & Engineering Company, Wickliffe, Ohio.

The control has been developed for systems in which package material is to be carried from one or two receiving stations to a large number of delivery stations. In operation, a train of carriers is moved around the tramrail system automatically by an electric propelling unit, each carrier being equipped with a photo-electric cell and relays which operate a magnetic latch for dumping the material when actuated by a stationary focusing light at the delivery station.

When the material is loaded on the carriers at the receiving station, each photo-electric tube is set in a position on a slide or selector bar to correspond to the position of the stationary focusing light at the desired delivery station. Thus, as the train travels around the system, the focusing light of each station strikes the photo-electric cell adjusted for that station and the magnetic latch releases the material from the carrier. The number of delivery stations may be doubled by turning the slide or selector bar to the right of the normal position. Open latch releases of each carrier are closed automatically before they return to the loading station.





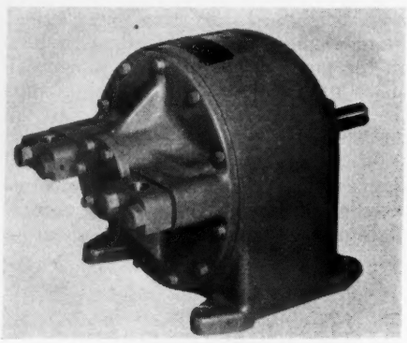
The illustrations show a photo-electric cell and selector bar unit and a delivery station for a system developed to sort mail bags and deliver them to preselected mail cars in a railroad terminal.

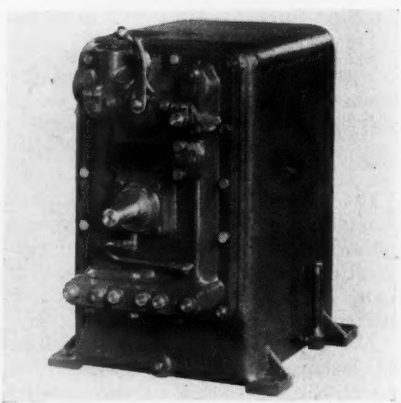
■

Oilgear Variable-Speed Hydraulic Transmission Unit

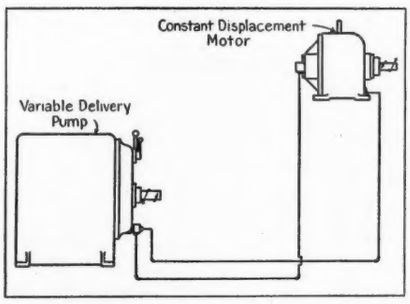
TWO ESSENTIAL parts comprise the variable-speed hydraulic transmission unit developed by The Oilgear Company, Milwaukee, Wis. They are a variable-displacement, constant-speed oil pump and a constant-displacement, variable-speed oil motor. When the pump is connected to a constant-speed source of power and piped to the motor, a variable-speed transmission results that can be applied to conveyors, papermill drives, and other machinery in which smooth, stepless speed variation is desired. By varying the displacement of the pump, the speed of the motor can be varied from 0 to 800 r.p.m., practically independent of variations in load.

The pump unit consists of a case which contains the rotating parts, control mechanism, and oil reservoir. Pump mechanism is arranged so that the displacement or oil pumped may be varied from zero to the maximum capacity by swinging an arm or pendulum. This action varies the eccentricity of a multiple cylinder block with relation to the fixed piston carrier. The pump is protected against overload by an adjustable relief valve. Ball or roller bearings are used throughout. Pumps are available for pressures up to 1,500 lb. per sq. in., requiring at the maximum a 7-hp. motor. At full stroke and load, efficiency is said to be 90 per cent.





Working parts of the motor are similar to those of the pump, except that the stroke is fixed. The speed is controlled by the operating lever on the pump. Motors are available for pressures up to 1,750 lb. per sq. in. with a maximum output of 6.9 horsepower.



The units usually are connected by a ¾-in. pressure and return line, together with a ¾-in. drain line. Direction of rotation may be reversed by interchanging the pipe connections.

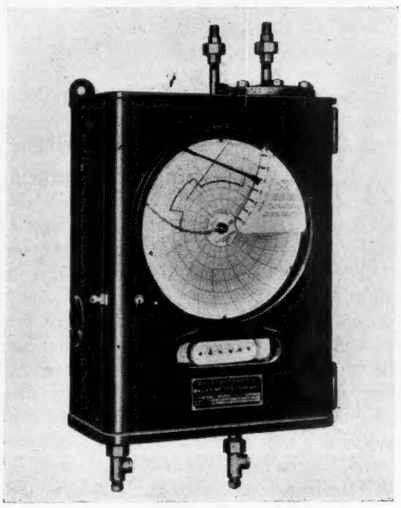
■

Bailey Ratio Meter

BAILEY Meter Company, Cleveland, Ohio, announces the development of a ratio meter for use as a combustion guide in the firing of gas- or oil-fired heaters, kilns, and industrial furnaces.

The instrument enables furnace operators to maintain a definite relation between the amounts of air and fuel supplied to the furnace. The meter contains two recording pens. One pen records the rate of oil flow and is actuated by a mechanism which receives its motive power from the differential pressure produced by an orifice in the fuel line. In similar manner, the other pen records the flow of air to the furnace. At the time the meter is being installed, a combustion test is run on the furnace to determine the most efficient ratio between air flow and fuel flow, and the air flow mechanism then is adjusted so that the ratio is obtained when the two records coincide. The furnace operator, therefore, keeps the two pens together by proper manipulation of the air supply to be assured that maximum economy is being secured.

The meter also records and indicates the rate of oil flow in any convenient terms, and the total flow may be given by a four-dial integrator which may be installed in the meter if desired. Units are so designed that auxiliary recorders of temperature or pressure may be used to give records of these factors on the same chart with the flow records.

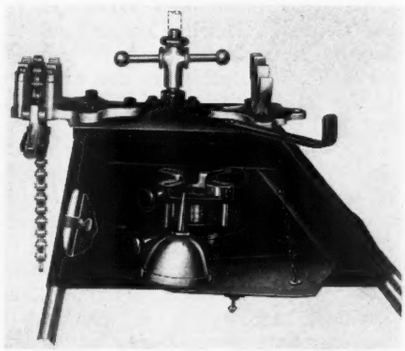


■

Hollands Combination Vise Stand and Tool Chest

HOLLANDS Manufacturing Company, Erie, Pa., announces a combination vise stand and tool chest. An adjustable brace may be extended to the ceiling with 1-in. pipe to hold the stand rigid. The triple-notched pipe rack has a fixture for bolting to the extension bench for pipe support. Four pieces of 1-in. pipe 45 in. long constitute the legs. The steel door is equipped with a lock and, when open, acts as a shelf for tools.

The equipment is made of welded 12-gage steel. The base measures 20x21 in.; the top, 9x12 in.; height 9 in.; and door opening 9x10 in., resulting in a



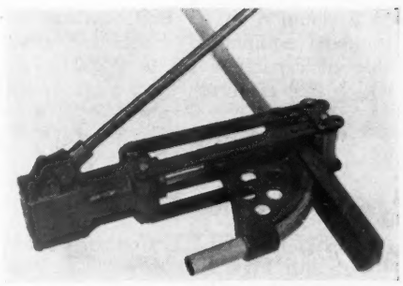
tool chest of ample capacity for holding a No. 2 die-stock head, a 24-in. wrench, a hacksaw, pliers, and fittings. The stand is finished in olive enamel and the fixtures in aluminum bronze. It weighs 75 lb. with vise, less the legs.

■

Greenlee Hydraulic Steel Tube Benders

GREENLEE Tool Company, Rockford, Ill., announces the No. 772 portable, hydraulic, steel-tube or thin-wall conduit bender developed especially for Steel & Tubes, Inc., Cleveland, Ohio.

The equipment consists of three tube shoes, three follow bars, two support rollers, four connecting bars, two cross bars, and the necessary fittings for their attachment to the machine. The tube shoes and follow bars, one each of which is required for every size of steel tube, are said to be so shaped that the steel tubing is not crushed or kinked when undergoing the bending operation. The power unit is the same as the No.



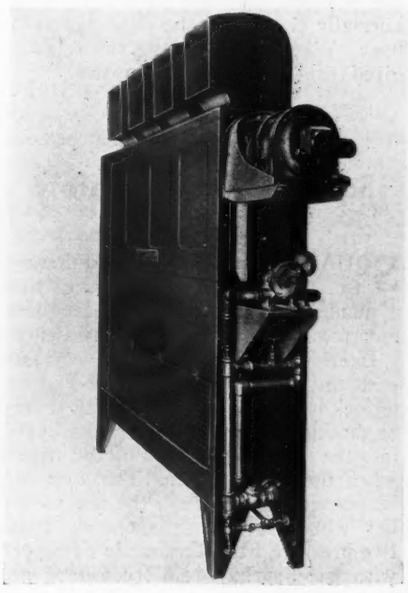
770 bender for standard conduit. The unit develops 25 tons total pressure and is designed to bend 1¼-, 1½-, and 2-in. steel tubes or thin-wall conduit, giving bending radii of 6½, 7¼, and 8¼ in. respectively.

■

Buffalo Unit Air Washers

UNIT AIR washers have been announced by the Buffalo Forge Company, Buffalo, N. Y. Essentially, they consist of spray nozzles, eliminator plates, heating coils, and two or more rotors for distributing the tempered air through overhead outlets. Heating coils, rotors, couplings, and bearings are similar to those used in the line of "Highboy" heaters.

In operation, the pump recirculates water to the spray nozzles under sufficient pressure to provide atomization. Air passing through the unit is drawn through the spray. The eliminator plates are used to take surplus moisture from the air after it has been washed. The air then passes through the heating coils and is distributed by the fans. Where heat is not required, the heating coils may be omitted. The unit also cools the air in hot weather. The "Universal Aerofin" heater unit is made of copper and brass and is suitable for steam pressures up to 20 lb. per sq. in. Rotors are multiblade design mounted

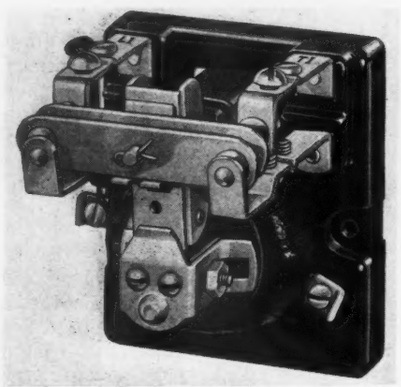


on a common shaft. Ball bearings are standard equipment. Units are available in capacities up to 7,260 c.f.m., which size is driven by a 5-hp. motor.

■

Allen-Bradley Contactors

ALLEN-BRADLEY Company, 1311 South First St., Milwaukee, Wis., announces the addition of two types of contactors, known as "Normally Closed" and "Up-and-Down" to its line. The former type, classified as Bulletin 201 Form D (d.c.) and Bulletin 701 Form D (a.c.), are provided with "down" or "back" contacts, against which a single-pole contactor arm is held when the operating coil is not energized. When the coil is energized, the circuit is opened. This type is designed for relay,



street-lighting, and traffic-signal applications.

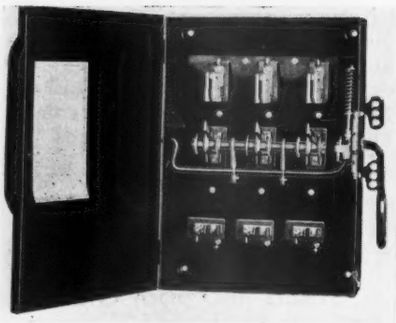
The other type, classified as Bulletin 201 Form E (d.c.) and Bulletin 701, Form E (a.c.) is a two-wire, single-pole, up-and-down contactor, provided with a double set of single-pole stationary contacts and a double contactor on the contactor arm. The two circuits are insulated from each other, one being normally closed and the other normally open. When the operating coil is energized, this condition is reversed.

■

Square D Type A Safety Switch

SQUARE D Company, 6060 Rivard St., Detroit, Mich., announces that a number of improvements have been incorporated in its Type A safety switch.

Interlock mechanism is more compact with fewer interlocking parts. The interlock is controlled by a key, but it may be disabled with a screw driver slipped into the slot for operation of the switch when the door is open. The door can be opened only through the use of the key when the switch is closed. Positive-pressure fuse clips, made of copper with steel-spring reinforcements, are

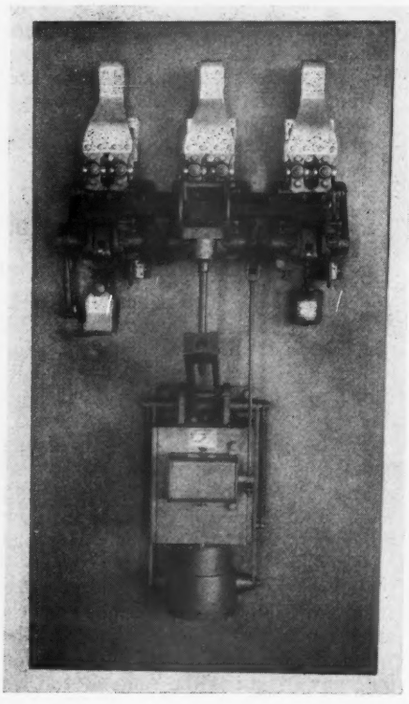


standard in the unit base assembly. Dust shields have been made wider, longer, and stronger. A slotted hexagon terminal nut is incorporated in switches of 100-amp. capacity or less.

■

General Electric Air Circuit Breakers

ELECTRICALLY operated, trip-free air circuit breakers, known as Type AL-1, have been announced by the General Electric Company, Schenectady, N. Y. Instruments are designed for 650-volt service and are available in normal ratings up to 4,000 amp. a.c., and 10,000 amp. d.c., based on contacts not exceeding a temperature rise of 20 deg. C. They are made in single-pole or multi-pole types. Each pole is self contained and of unit-frame construction. The multi-pole types are two or more single-pole units mechanically interconnected for group operation. Breakers can be equipped with instantaneous time overcurrent, or undervoltage trips, and auxiliary switches.



Bonney "Weldolets" and "Thredolets"

TWO TYPES of drop-forged pipe fittings for making welded tee junctions have been announced by the Bonney Forge and Tool Works, Allentown, Pa. They are trademarked "Weldolets" and "Thredolets." The former type is used for welded pipe installations and requires two welds, one at the line of contact with the main pipe, and the other where the branch and outlet of the "Weldolet" join. Because their outlets are tapped, "Thredolets" require but one weld. They are especially suit-

able for use in low-pressure heating systems. The illustration shows a "Weldolet" in position on the main pipe ready for tacking and welding.

■

Diamond Rubber Belt Dressing

DRESSING for rubber belts in stick form has been announced by The Diamond Rubber Company, Inc., Akron, Ohio. The announcement states that it contains no oil, grease, or chemicals harmful to belt or pulley; is not inflammable; and increases the pulling power of the belt.

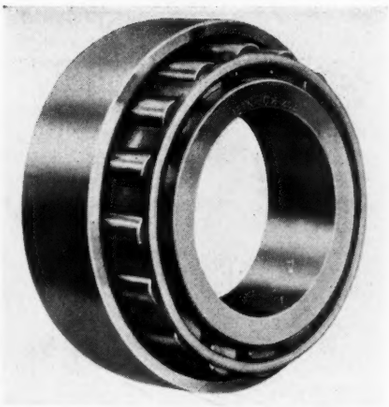
■

Aetna Roller Bearings

AETNA Ball Bearing Manufacturing Company, 4600 Schubert Ave., Chicago, Ill., has introduced a line of roller bearings for heavy-duty service.

The outer race is free from lips or shoulders, while the inner race has a double lip. Because the rollers are free to move longitudinally across the face of the outer race, endwise movement of the shaft is permissible without misalignment or cramping. Rollers and races are made of hardened and ground steel. Cages may be either steel or brass.

The line consists of the CR-200, CR-

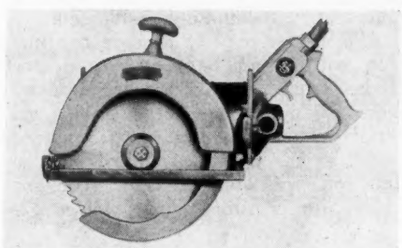


300, and CR-400 Series for light, medium, and heavy duty, a total of 64 bearings ranging in outside diameter from $1\frac{3}{16}$ to $10\frac{7}{16}$ in. Bearings are standardized to make them interchangeable with other makes and types.

■

United States Portable Saw

ANNOUNCEMENT is made of a portable, electric hand saw by The United States Electrical Tool Company, 2940 West 6th St., Cincinnati, Ohio. The machine is said to perform most of the necessary sawing operations, including cross, rip, plane, rafter, and bevel sawing, as well as to pocket-cut stone or slate. Two adjustments set the saw for any depth up to $4\frac{1}{8}$ in. and any angle up to 60 deg. A blower keeps the sawdust away from the markings. Other features are top and automatic bottom guards, ball bearings throughout, and a heat-treated, double-reduction

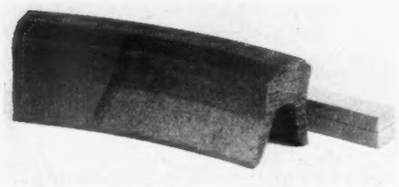


gear. The universal motor can be operated on 110-, 220-, or 250-volt circuits. The large saw is 26 lb. in weight.

■

Diamond U-Type Hydraulic Packing

"RUBBER Crimps," U-type hydraulic packing, for service on hydraulic rams and presses, has been announced by The Diamond Rubber Company, Inc., Akron, Ohio. The rubber is compounded to resist oil, and is covered almost completely with a layer of fabric, which helps to maintain the $\frac{1}{4}$-in. flare at the bottom. The packing is applicable for pressures up to 3,000 lb. per sq. in., and is said to be unaffected by the heat generated in hydraulic presses. It can be furnished in any standard diameter.



■

Elwell-Parker Electric Trucks

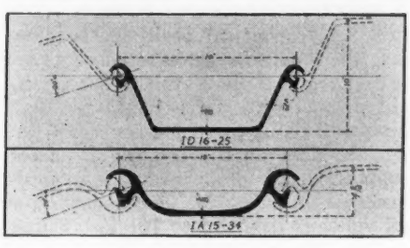
TYPE ERF telescoping fork trucks have been announced by The Elwell-Parker Electric Company, Cleveland, Ohio. Trucks are intended for medium duty, and the three-wheel design is said to provide for easy turning and maneuvering in a limited space. Telescoping uprights, to which are attached the forks supporting the load, permit stacking at a height of 96 in. The uprights may be tilted, bringing the load back over the main portion of

the truck. Forks require a 2-in. clearance beneath the load. Units can operate in a 7-ft. headroom.

■

Inland Steel Sheet Piling

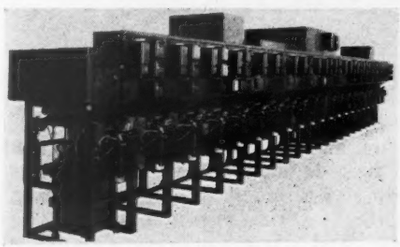
INLAND Steel Company, Chicago, Ill., announces that it has added steel sheet piling to its products. Two sections are now available. Section IA 15-34 weighs 42½ lb. per ft. and 34 lb. per sq. ft. of wall, while section ID 16-25 weighs 33 1/3 lb. per ft. and 25 lb. per sq. ft. of wall. Other sections will be added to complete the line. The piling has been designed to provide driving qualities, and a strong interlock.



■

General Electric Metal-Clad Switchgear

TYPE M1-3 metal-clad switchgear has been announced by the General Electric Company, Schenectady, N. Y. It accommodates oil circuit breakers having an interrupting capacity of 65,-



000 kva. at 7,500 volts and is available in normal ratings up to 1,200 amp. The units can be furnished with manual solenoid, or motor-operated mechanisms, according to specification.

■

Allis-Chalmers Acquires Condit and Brown Boveri

ANNOUNCEMENT is made by the Allis-Chalmers Manufacturing Company, of Milwaukee, Wis., of the acquisition of the principal assets of the American Brown Boveri Company, Inc., and the capital stock of Condit Electrical Manufacturing Corporation, of Boston, Mass. By this purchase Allis-Chalmers secures several new lines of equipment, such as mercury arc rectifiers, blowers, electric furnaces, and oil circuit breakers.

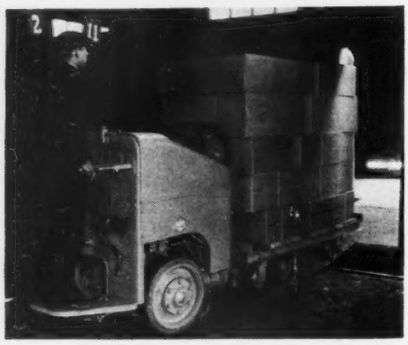
After completing the manufacture of goods on order at Camden, N. J., the operations now carried on by the American Brown Boveri Company, Inc., will be segregated. The large apparatus departments and work, with substantially the same personnel, will be transferred to the Allis-Chalmers plants at Milwaukee and Pittsburgh, while the remainder will be moved to the plant of the Condit Electrical Manufacturing Corporation at Boston, Mass.

The corporate entity, the organization, plant, and product of the Condit Electrical Manufacturing Corporation of Boston, for 31 years manufacturers of oil circuit breakers, will be retained as at present.

Clark "Truclifts"

GASOLINE-DRIVEN lift trucks, with four-wheel steer and rear-wheel drive, have been announced by the Clark Tructractor Company, Battle Creek, Mich. They are known as "Truclifts."

According to the announcement,



trucks can be turned on a small enough radius to enable them to enter freight cars and spot loads at the far end. Power is delivered to the two rear wheels through direct transmission. Other features are a locomotive-type cast-steel frame, full-floating rear axle, hydraulic lifting mechanism with automatic control, and a tractor-type gasoline engine with its speed governed to less than 1,400 r.p.m. One model, equipped with a narrow pointed platform, is said to lift 3-ton loads in 9 sec., and will turn in a 94-in. radius. A heavier model has a speed of from 1 to 6 m.p.h., a 94-in. turning radius, and is said to lift 4 tons in 8 seconds.

■

Vickers Hydraulic Relief Valve

VICKERS Incorporated, 7766 Dubois St., Detroit, Mich., announces a hydraulic relief valve operated by a piston said to be in hydraulic balance regardless of the initial oil pressure and the pressure for which the valve is set. This feature is claimed to eliminate surging and chatter. The valve is controlled by turning the adjusting screw, which varies the pressure from one extreme to the other. Working parts are of hardened and ground alloy steel. Valves are available for ¾-in. and 1¼-in. pipe connections. Capacities are 0 to 15 g.p.m., and 10 to 40 g.p.m., respectively. The pressure range is 0 to 2,000 lb. per sq. in. for both sizes.

■

General Electric Moisture-Content Indicator

DEVELOPMENT of an instrument that determines the moisture content of lumber has been announced by the General Electric Company, Schenectady, N. Y. The device utilizes the relation between the electric resistance of wood and its moisture content for its principle of operation.

The circuit of the instrument contains two neon glow lamps. One lamp is connected across a fixed condenser, so adjusted that, when the condenser builds up current to a certain point, the neon tube discharges with its characteristic red flash. This rate of flashing is adjusted to about once per second. The other neon lamp and its condenser are in series with a hammer with knife edged electrodes which are driven into the wood to be tested. The rate at which the condenser builds up its charge depends upon the conductivity, and therefore the moisture content of the wood. By means of a variable condenser, the circuit is adjusted so that the two lamps flash simultaneously. Then the dial of the variable condenser shows the percentage of moisture in the lumber. The adjustment also can be made by listening to a buzz in earphones. The instrument reads between 7 and 24 per cent moisture content.

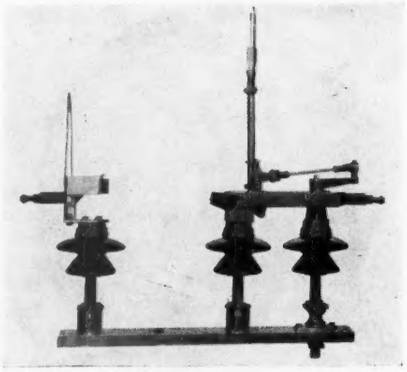
The indicator is a self-contained unit inclosed in a portable metal case, current being supplied by B batteries totaling 135 volts.

■

Delta-Star High-Voltage Switch

DELTA-STAR Electric Company, 2400 Block, Fulton St., Chicago, Ill., has developed a gang-operated, air-break switch known as Type MB-139. By a simple link motion the blade first is withdrawn from the contacts, then raised to a vertical position. In closing, the operation is reversed.

Contacts are of the full-floating, self-aligning type. Greaseless-type ball bearings with corrosion-resisting liners are used on the rotating insulator support. Insulators are rated in accordance with the N.E.M.A. Standards for all voltages from 7.5 to 161 kv. Either



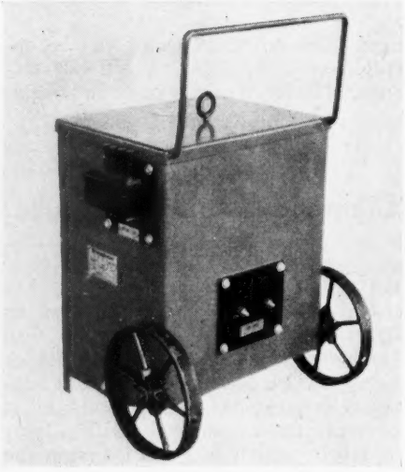
single-bolt or four-bolt insulator units may be furnished. Operating handles are torsion type with provision for padlocking, except for heavy ampere capacities where a gear mechanism is used. For load-break purposes, arcing horns are provided but, for simple disconnects, the horns are omitted and the switches can be mounted upright, underhung, or with the base in a vertical position. The illustration shows a single-pole unit.

■

Westinghouse "Flex-Arc" Welder

AN A.C. arc-welding set designed for operation at currents between 8.5 and 125 amp. has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It is designed to meet the demands for economical arc welding of thin-gage materials such as are encountered in the manufacture of metal furniture, sheet-iron cabinets, job and garage repair work, and ventilating and materials-handling equipment.

The welder may be used in conjunction with either bare or coated electrodes from 1/32 to 1/8 in. in diameter. Many of the ferrous-alloy materials commonly used with reversed-polarity d.c. may be applied in conjunction with the welder. The machine also is said to have welded alu-

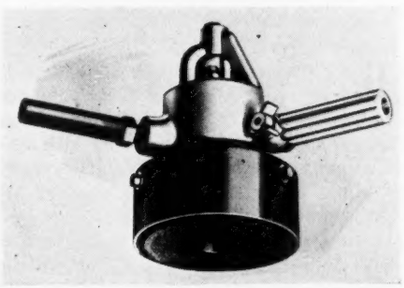


minum successfully. The equipment, consisting of a special self-cooled transformer, a short-wave arc-control system, and current-regulating details, is mounted in a welded-steel case. A special, high-frequency arc-stabilizing circuit is said to eliminate the usual high, open-circuit, secondary voltage. Short-wave arc control is claimed to eliminate the interference to radio reception often caused by a.c. welders.

■

Ingersoll-Rand "Multi-Vane" Grinder and Sander

INGERSOL-RAND Company, 11 Broadway, New York, N. Y., announces a grinder and sander of the "Multi-Vane" type, known as Size 4F, which can be fitted with a grinding wheel, sanding head, or wire brush.



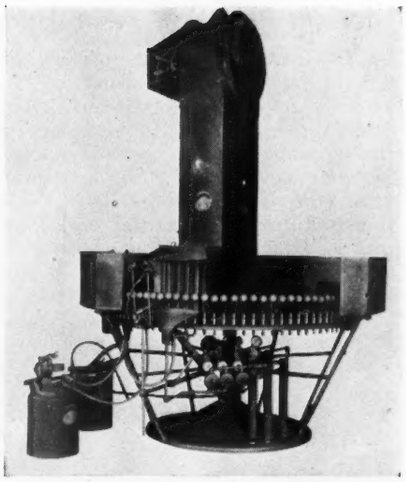
Typical applications are sanding and polishing automobile bodies, smoothing down welds, cleaning and surfacing castings for painting, sanding metal furniture, and wire brushing.

The machine is built with two handles so that the operator can hold it at right angles to the working surface. One of the handles may be removed to facilitate working in close quarters. The second handle acts as the air inlet and contains a thumb-controlled throttle valve. Standard free speed is 4,600 r.p.m., but units can be furnished for higher or lower speeds. Overspeed is prevented by a governor. The unit weighs 10¾ lb. and has an overall length of 9¼ in. without the adjustable guard for grinding wheels.

■

Paasche Automatic Aircoating and Drying Machine

PAASCHE Airbrush Company, 1909 Diversey Parkway, Chicago, Ill., announces a 90-spindle aircoating and drying machine known as Type F-632, which depends upon air pressure for its operation. The machine is said to have a coating capacity that depends entirely upon the facilities and speed with which it is loaded and unloaded.



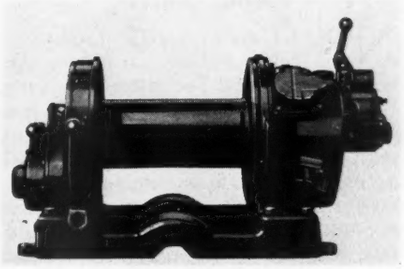
Required amount of air is 20 to 30 cu. ft. per min. at 5 to 70 lb. per sq. in. Features are welded steel construction; adjustable-speed air motor equipped with self-aligning ball bearings; adjustable, removable spindles with cam rollers and gears; water and oil separators; automatic on and off control; universal swivel sliding gun; "Clamptight" cover pressure tanks; and a triple-wall, asbestos-lined, drying tunnel. The automatic, convertible air brushes are available in desired numbers to control the coating from a fine line to a broad spray. The ventilating unit is said to be fireproof. Material collectors are removable for cleaning. A table speed of 1 r.p.m. will coat and dry 90 pieces per minute; a table speed of 2 r.p.m. will handle 180 pieces per minute.

The equipment may be built in sizes to accommodate practically any product or for use in connection with chain or belt conveyors.

■

Ingersoll-Rand "Utility" Hoist

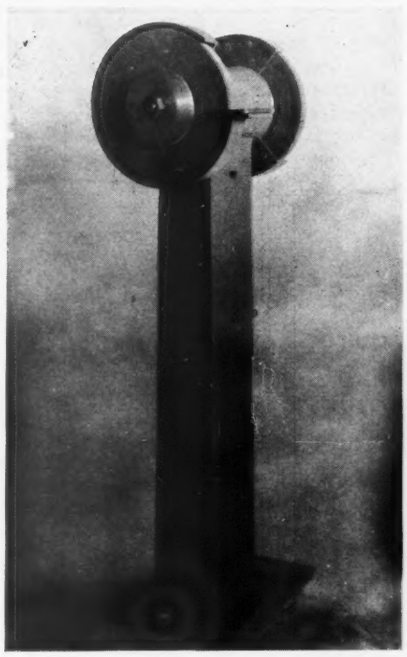
ADDITION of Size HUL to its line of "Utility" hoists has been announced by the Ingersoll-Rand Company, 11 Broadway, New York, N. Y. The unit has a longer drum and a greater cable capacity than any previous member of the line. It provides for 2,900 ft. of ¼-in. cable, 1,400 ft. of ⅜-in. cable or 800 ft. of ½-in. cable. Rated working capacity at 80 lb. per sq. in., air pressure is 2,000 lb. at a rope speed of 120 f.p.m. Ball or roller bearings are used throughout the reversible, 4-cyl., radial-piston air motor. The hoist is controlled through a jaw-type clutch and an external contracting-type brake.



■

Forbes & Myers Grinder

WELDED steel construction features the electric tool grinder announced by Forbes & Myers, 172 Union St., Worcester, Mass. The two wheels, 10 in. in diameter by 1 in. wide,



mounted on the motor shaft, operate at 1,800 r.p.m. The tool rest is provided on the left side only and is adjustable in two directions. Both wheels have permanent guards, the right wheel guard having a larger opening for work that cannot be handled on the regular tool rest. Ball bearings are of the grease-seal type. The ¾-hp. induction motor is inclosed and cooled by the circulation of air through the stand. It may be furnished for any standard voltage up to 550; 1, 2, or 3 phase; 25 or 60 cycles. The switch is mounted in the base. The machine weighs 90 lb. and is available in a black or gray finish.

■

Linde "Oxweld" Goggles

WELDERS' goggles, known as "Oxweld" No. 12, have been announced by The Linde Air Products Company, 30 East 42nd St., New York, N. Y. The edge of the cup coming in contact with the face is shaped to conform to the welder's cheekbone and

nose. Eye-pieces are joined by a leather strap, adjusted by a metal buckle. Ventilation ports on each side of the eye-cups are designed to prevent sparks or light from reaching the inside of the cup. The 50-mm. lenses are available in three shades of green or in a brown color. Lenses may be changed by unscrewing the metal cups from the frames of the eye-pieces. Goggles are made from "Oxweldite," a molded plastic substance formed over a fabric base. The material is said to be resistant to heat, light, and electricity.

■

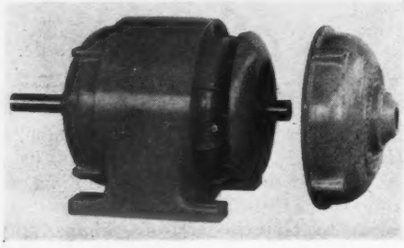
U. S. Hame Company Acquires Lawson Manufacturing Company and Warner Hammer Company

PURCHASE of the assets of the Lawson Manufacturing Company, Cleveland, Ohio, and the Warner Hammer Company, Cromwell, Conn., is announced by the U. S. Hame Company, Buffalo, N. Y. Lawson wrenches and Warner hammers and chisels will be marketed under the trade name "USHCO."

■

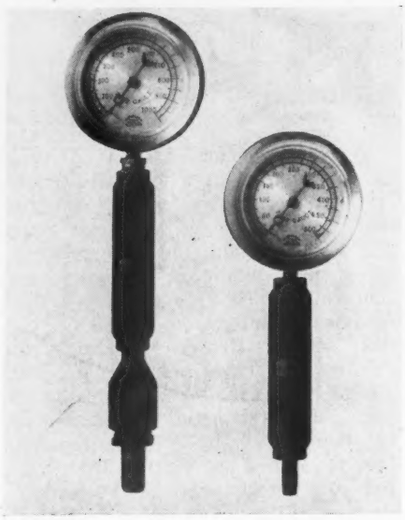
Sterling "Klosd-Tite" Motors

TOTALLY inclosed, fan-cooled motors, known as "Klosd-Tite" units, have been announced by Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles, Calif. Two iron cases, an inner and an outer, completely inclose the bearings, air gap, rotor and windings. Air is circulated over the external surface of the inner housing by a fan at one end. Other construction features are sealed ball bearings and mica- and asbestos-insulated windings.



Meriam Pulsation Absorbers

ALL-WELDED pulsation shock absorbers have been announced by The Meriam Company, Cleveland, Ohio. They are designed to eliminate the unsteady readings of pressure or vacuum gages attached to pipe lines with pulsating flow. The instrument is placed in the small line leading to the gage. Fluctuations from the gage-line pressure are absorbed by air receiver action and the friction of the fluid or gas as it is forced through coils of fine tubing



within the compressor air chamber of the gage. Absorbers are designed for line pressures up to 10,000 lb. per sq. in. and are 7 in. high.

■

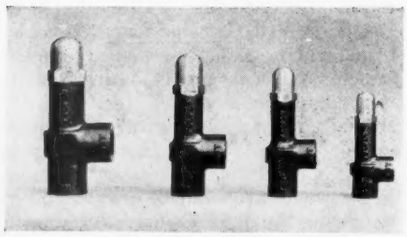
Republic "Champion" V-Belts

ADDITION of V-belts to its line of "Champion" products has been announced by The Republic Rubber Company, Youngstown, Ohio. Belts are available in five sizes ranging from ½x11/32 in. to 1½x1 in. The smallest size is designed for a minimum sheave diameter of 3½ in., the largest, 22 in. They are built in lengths for standard drives.

■

Fulflo Non-Chattering Relief Valves

NON-CHATTERING, piston-type oil relief valves have been announced by Fulflo Specialties Company, Blanchester, Ohio. Some important uses of the fittings are found in connection with oil-hydraulic pumping units, such as machine-tool hydraulic mechanisms, oil-burning equipment, rams, and presses, in which it is desired to maintain a specific pressure.



The cylindrical piston seat closes off the port in a shearing manner. Adjustment is accomplished by removing the cap and turning the screw at the top. Valves are made in pipe sizes ranging from ⅜ to 1¼ in. and for pressures from 20 to 120 lb. per sq. in. Construction may be cast iron with brass piston or all bronze.

■

Lincoln "Manganweld" Electrodes

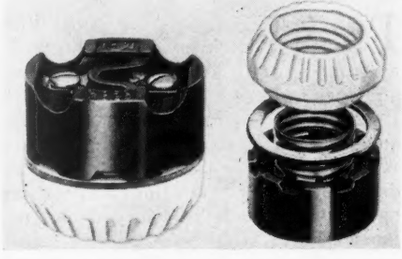
ELECTRODES, containing 11 to 15 per cent manganese steel and known as "Manganweld," have been announced by The Lincoln Electric Company, 12818 Coit Rd., Cleveland, Ohio. They utilize the shielded-arc process to build up manganese steel castings in producing a weld that is said to have the structure and quality of wear-resisting, cast manganese steel and to be air toughening. A heavy extruded coating is said to provide a shielded arc which allows the transfer of metal to take place under non-oxidizing conditions.

Electrodes are made in ⅛-, 5/32-, 3/16-, and ¼-in. sizes of the standard 14-in. lengths.

■

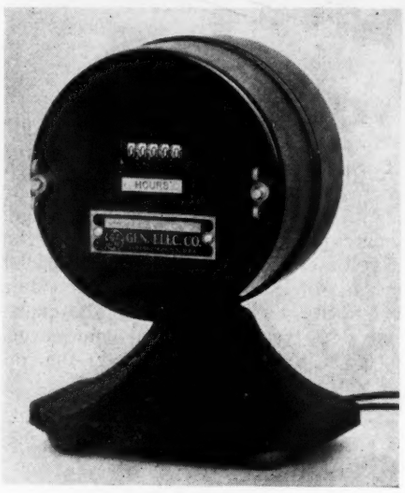
Cutler-Hammer Receptacles

SCREW-RING receptacles, including screw-terminal, loop-terminal, and wire-lead types, have been announced by Cutler-Hammer, Inc., 253 North 12th St., Milwaukee, Wis. Features include shatter-proof bodies made of "Thermoplax," porcelain screw rings, removable screw shells made of copper, and staked terminal screws. Receptacles are rated at 660 watts, 250 volts.



General Electric Time Meters

TIME meters, which show the actual total operating time of any electric equipment using alternating current, have been announced by the General Electric Company, Schenectady, N. Y. A synchronous motor within each meter drives a cyclometer five-digit counter while the circuit of the equipment is closed. The counter may be arranged to read in either hours or minutes. Meters are available with pedestals for portable use or threaded connections for permanent mounting on conduits. In-



struments are designed for 110-, 220-, or 440-volt circuits at 25, 50, or 60 cycles; but no one instrument has more than one voltage or frequency rating.

■

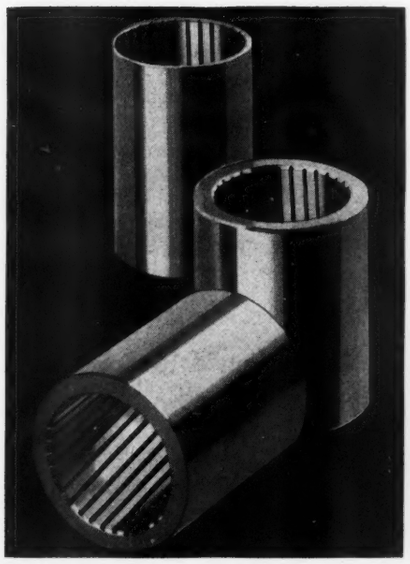
Charles R. Long, Jr., Company to Manufacture and Distribute Liquid Metal Products "Stibloy"

LIQUID Metal Products, Inc., 126 North Clinton St., Chicago, Ill., announces that it has licensed Charles R. Long, Jr., Company, Louisville, Ky., to manufacture and distribute its line of liquid metal coating, known as "Stibloy." The coating is used to protect galvanized metal from corrosion and to provide an adhesive surface for the application of paint.

■

Johnson "Self-Lubricating" Bronze Bushings

CAST-PHOSPHOR-BRONZE, graphite-impregnated bushings have been announced by the Johnson Bronze Company, New Castle, Pa. Dove-tailed



grooves, approximately $\frac{1}{32}$ in. wide, have been cut into the bearing surfaces longitudinally at an angle of 7 deg. The grooves are said to hold the lubricating compound permanently in place and permit 40 to 45 per cent of the bearing surface to be graphite impregnated.

■

General Electric Ultra-Violet Lamps

DEVELOPMENT of three types of ultra-violet lamps in addition to Type S-1 has been announced by the General Electric Company, Nela Park, Cleveland, Ohio. They are known as Types S-2, G-1, and CX.

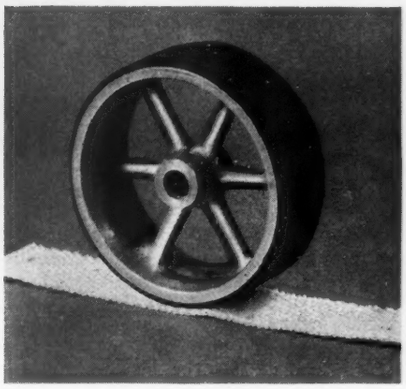
Although Type S-2 is designed fundamentally the same as the earlier type, several additional features have been incorporated. The arc length has been increased and a metal cap has been placed over the lower portion of the bulb. A larger screw base is provided than is used for ordinary house circuits to prevent the lamp from being inserted in standard lighting sockets. The lamp starts on 2-amp., 30-volt current and draws 8½ amp. at 15 volts when in operation. Small transformers are available for operating the lamps, a separate transformer being required for each lamp. Lamp and transformer draw a total of 175 watts.

The second lamp is known as Type G-1 or glow lamp. It consists of two heater filaments, a connecting and supporting bridge, center support, and a pool of mercury. Ultra-violet radiation is produced by means of a glow discharge in the mercury vapor. The lamp starts on 2-amp., 35-volt current and draws 2 amp. at 20 volts when in operation. Separate transformers are required for each lamp. Lamp and transformer require approximately 50 watts.

Type CX lamps are of low ultra-violet output and are available in the 60- and 500-watt sizes.

Gripwell Pulley Surface Covering

"GRIPWELL" is the name of a pulley-surface covering developed by the Gripwell Manufacturing Company, 40 East 34th St., New York, N. Y. It is designed to improve the frictional contact between the belt and pulley face and thereby reduce slippage to a minimum. The product consists of a special compound used in



connection with a treated canvas band. It is applied to cast-iron, wood, or steel pulleys.

The compound is said to contain preservative qualities, which penetrate the pores of the belt.

■

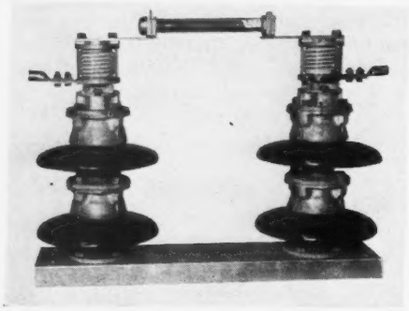
Howell Motors with Double-Seal Ball Bearings

HOWELL Electric Motors Company, Howell, Mich., announces that double-sealed ball bearings have been adopted as standard for its line of Red Band motors. Balls and race-ways

of the bearings are packed in congealed oil and sealed in a dust-proof room at the point of manufacture. Seals consist of two plates, one on each side.

Delta-Star Mounted Fuse Unit

DELTA-STAR Electric Company, 2400 Block, Fulton St., Chicago, Ill., announces a single-pole, 1-amp. fuse unit designed for mounting on the side

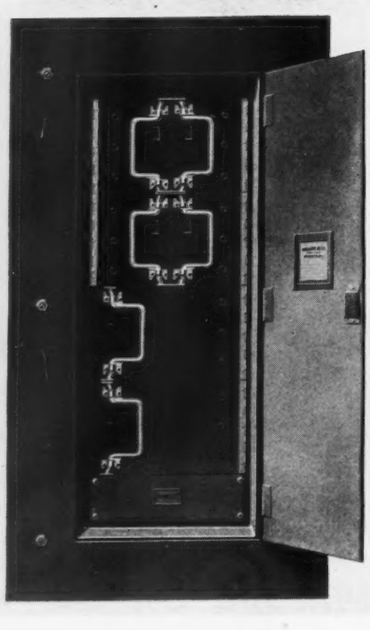


of a structure when used for potential transformer protection in high-capacity outdoor substations. To each insulator support is attached a glass-inclosed resistor unit in series with a fuse to limit the current under abnormal conditions. The unit is designed for 15-kv. operation with a dry flash-over value of 140 kv. and a wet value of 80 kv. at 60 cycles.

■

Square D Safety Panels

SHALLOW safety panelboards have been announced by the Square D Company, Detroit, Mich. Cabinets are 6 in. deep and 19 in. wide and can be supplied for either flush or surface mounting. Flush-mounted units have trims equipped with self-adjusting trim clamps. Surface-mounted cabinets are supplied with hinged gutter covers and door. Combination panels, including lighting-panel sections, can be built up



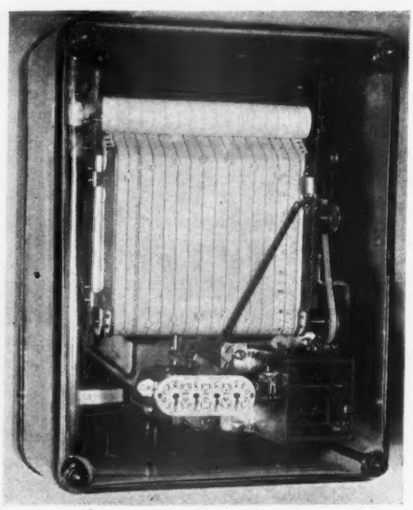
for applications in which a combination power and lighting panelboard is desired. Other features include holes in the door for fuse tests, swivel blade holders, and flush-type door locks and latches.

Twin units are convertible between 30 and 60 amp., 125 or 250 volts, while single units are convertible for 30-, 60- or 100-amp. fuse clips, 125 or 250 volts. All units are interchangeable.

■

Westinghouse Recording-Demand Watthour Meter

WESTINGHOUSE Electric & Manufacturing Company, East Pittsburgh, Pa., announces a recording-demand watthour meter, known as Type RB, which indicates on a four-counter dial the total kw. hr. consumed and records on a chart the integrated demand



in kw. over successive, predetermined time intervals.

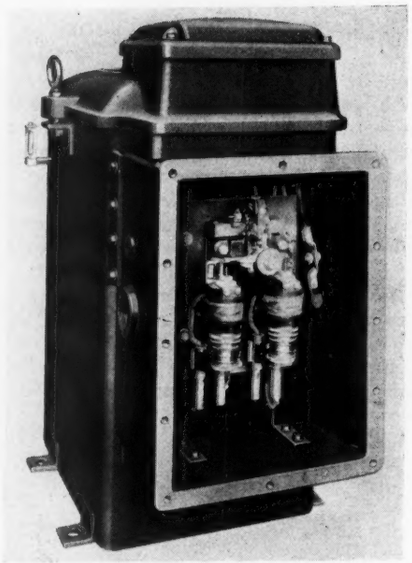
The meter is available only with a synchronous-motor clock for two- or three-phase, four-wire, and two- or three-phase, three-wire service. It is self-contained and requires no additional apparatus or wiring except when used with instrument transformers.

■

Electric Controller Explosion-Proof Motor Starter

EXPLOSION-PROOF motor starters have been announced by The Electric Controller & Manufacturing Company, 2700 East 79th St., Cleveland, Ohio.

The illustration shows Type ZS across-the-line starter for full-voltage starting of squirrel-cage motors. It also may be used with an automatic-field switching panel for synchronous motors and for the control of the primary of

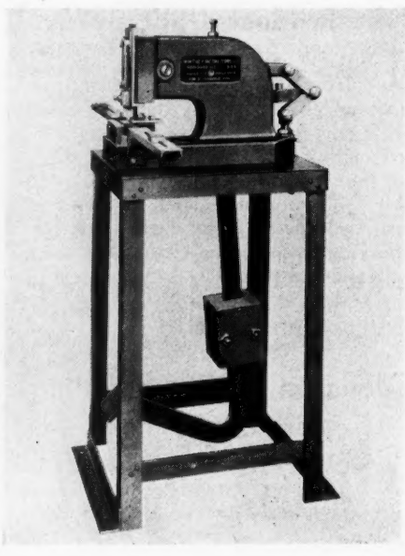


slipring motors. The oil tank, which contains the main-line contactor, is equipped with an oil-level sight gage. The explosion-proof case, bolted to the rear of the tank, contains the overload relay panel and serves as a conduit connection box. Leads from the main-line contactor for external connections pass through stuffing boxes in the top of the case.

■

Whitney Foot Press

WHITNEY Metal Company, 751 Race St., Rockford, Ill., announces a toggle-lever foot press, known as No. 28, capable of punching a 2-in. hole in 16-gage sheet. Throat depth is 7 in.; throat height, 4 in.; slug-clearance hole, 4 in.; and stroke of ram, 1 in. Features are adjustable ram regulation; positive stop, locking against crank arm; adjustable foot pedal; and bolster-plate die holder with a T-slot to clamp on stops or stripper plates. Speed is 100 holes per minute.



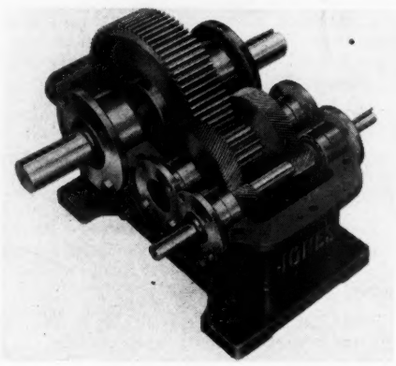
Eskah "Wood-Metal"

ESKAH Engineering Corporation, 259 Delaware Ave., Buffalo, N.Y., announces the development of a product known as "wood-metal." By a pressure and temperature process, metal is infused into woods of various varieties. The announcement states that infusion may be carried on from a surface coating to a full saturation and that the inherent structure of the wood is retained, so that it can be worked with conventional equipment such as saws, planes, and drills. According to the announcement, joints may be glued and soldered and the surface buffed and electroplated like solid metal.

■

Jones Speed Reducers

W. A. JONES Foundry & Machine Company, 4401 Roosevelt Rd., Chicago, Ill., announces the development of a line of small Herringbone-Maag speed reducers. Capacities range up to 18 hp., and reduction ratios range from 12 to 1 to 48 to 1. The smallest



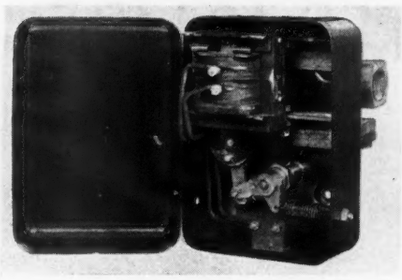
unit is 20⅝ in. long, 14¼ in. high, 10¼ in. wide. High- and low-speed shaft extensions on both sides and two shaft guards are provided.

■

General Electric Solenoid-Operated Valve

A SOLENOID-OPERATED valve, designated CR-9507-A1, for controlling liquids and gases under pressure has been announced by the General Electric Company, Schenectady, N. Y. Some of its applications are for operating steam or air whistles; controlling the flow of brine through cooling pipes in cold-storage rooms; remotely or automatically controlling the supply of oil or gas to furnaces; automatically controlling the flow of liquids in connection with weighing machines; and controlling the flow of water in cooling jackets on compressors.

The body is cast in two sections, fas-



tened together by bolts. Threads for pipe connections are standard. The valve is of the unbalanced type. It can be made to operate normally open or normally closed. A sheet-metal case with a hinged cover incloses the solenoid and operating mechanism.

■

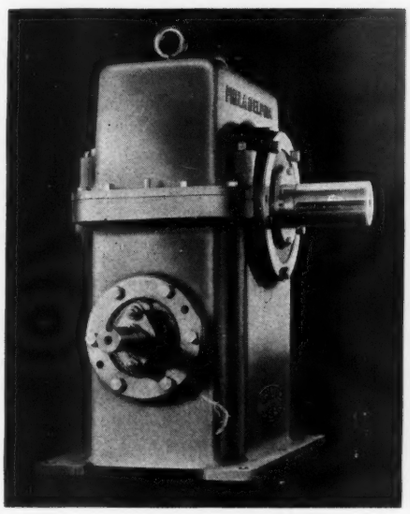
Columbia D.C. Generators

DEVELOPMENT of a line of low-voltage type d.c. generators, designed especially for electrolytic work, is announced by the Columbia Electric Manufacturing Company, 1292 East 53rd St., Cleveland, Ohio. Standard voltages are 12, 24, and 50, with capacities up to 100 kw. Design, construction, and appearance are similar to the line of 6-volt electroplating generators, with such features as rolled-steel, butt-welded frames; bracket-bearing construction; double-row Timken roller bearings; and interpoles. Generators may be furnished either with self-excited or separately excited fields.

■

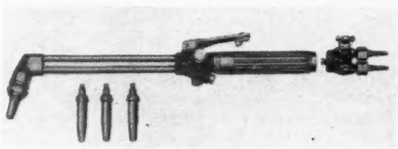
Philadelphia Steel Speed-Reducer Housings

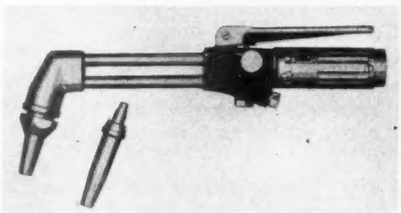
PHILADELPHIA Gear Works, Erie Ave., Philadelphia, Pa., announces that its entire line of speed reducers now is available with welded, rolled-steel housings as standard equipment.



Linde "Prest-O-Weld" Cutting Apparatus

TWO ADDITIONS to the "Prest-O-Weld" line of medium-pressure apparatus of the detachable-body design, known as the Type C-105 cutting blowpipe and the Type CW-105 cutting attachment, are announced by The Linde Air Products Company, 30 East 42nd St., New York, N. Y. Both types can be used with the same detachable valve body. The locking device for connecting the body to any one of the blowpipe handles consists of a locking bolt and wedge-shaped locking screw. The





locking screw operates by turning a ring and draws the detachable valve body and blowpipe handle together, making a gas-tight joint.

Pressure forgings are used in the construction of the blowpipe head and cutting-valve body and lever. The cutting oxygen tube is made of "Ambrac," a special, hard brass. The blowpipe is furnished as standard with four cutting nozzles and a 75-deg. angle head. If desired, a 90-deg. angle head can be furnished.

The cutting attachment is of single-joint design and attaches directly to the valve body. The attachment is 11 in. in overall length.

■

Maxim-Campbell Silencer and Air Filter Unit

THE MAXIM Silencer Company, Hartford, Conn., announces that, for the marketing and manufacturing of its window silencer, it has combined with the Campbell Metal Window Corporation, Pershing Square Building, New York, N. Y., a subsidiary of the American Radiator Company. The combined unit, known as the Maxim-Campbell silencer and air filter, is designed to eliminate outside noise and to filter the air entering any type of building. Essentially, it is a metal box 10 in. high and 12 in. deep, built to fit the width of the window and to rest on the window sill.

TRADE LITERATURE

For copies, address the manufacturers concerned

■

(263) FENCE—Booklet, typical fence installations, style sheets of chain-link and wrought-iron picket fences.—Page Steel & Wire Company, Bridgeport, Conn.

(264) METALLIC TUBING—Booklet, 12 pages, "Answering Your Questions About Bending Steeltubes."—Steel and Tubes, Inc., 224 E. 131st St., Cleveland, Ohio.

(265) SWITCHGEAR—Circular 1915, 12 pages, various types of metal-inclosed switchgear.—Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

(266) LIGHTING—Form 510, 8 pages, Thompson Safety Lowering Hanger.—The Thompson Electric Company, 1458 W. 9th St., Cleveland, Ohio.

(267) PANELBOARDS—Bulletin CA505A, 8 pages, shallow-type, safety panelboard.—Square D Company, Detroit, Mich.

(268) ALLEGHENY METAL—Booklet, 20 pages, illustrations of some of the recent uses of this metal.—Allegheny Steel Company, Brackenridge, Pa.

(269) MOTORS—Bulletin 520, 16 pages, descriptive and application data and dimension charts on synchronous motors.—The Ideal Electric and Manufacturing Company, Mansfield, Ohio.

(270) SPEED REDUCERS — Worm-gear Speed Reducer Book, construction and application details, installation photographs.—W. A. Jones Foundry & Machine Company, 4401 W. Roosevelt Rd., Chicago, Ill.

(271) WIRE ROPE — "Wire Engineering", June-July issue, data on the removal of elevator ropes from service.—John A. Roebling Sons Company, Trenton, N. J.

(272) AIR HEATERS—Booklet, vertical, tubular air heater.—The Babcock & Wilcox Company, 85 Liberty St., New York, N. Y.

(273) MATERIALS HANDLING — Catalog, standard and special elevating and conveying machinery.—The Fairfield Engineering Company, Marion, Ohio.

(274) FURNACES — Bulletin 841, 16 pages, "Automatic Reversal of Open-Hearth Furnaces."—Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.

(275) SPEED REDUCERS—Catalog 31, 128 pages, 8 types of worm-gear speed reducers.—The Horsburgh & Scott Company, 5114 Hamilton Ave., N. E., Cleveland, Ohio.

(276) MATERIALS HANDLING — 32-in. Sandvik steel belting.—Sandvik Conveyor Manufacturing Company, 21 Amsterdam St., Newark, N. J.

(277) WRENCHES—Folder, 4 pages, production socket wrenches and drivers conforming to the new G. M. C. socket-wrench standards.—Blackhawk Manufacturing Company, Milwaukee, Wis.

(278) CHAIN—Booklet, standard sling chain specifications, definitions, cautions, and instructions governing the purchase and use of chain.—American Chain Company, Inc., Bridgeport, Conn.

(279) BEARINGS — Bulletin S-349, 4 pages, steel-backed, babbitt-lined bearings.—Wagner Electric Corporation, 6300 Plymouth Ave., St. Louis, Mo.

(280) PROCESS EQUIPMENT — Bulletin, fabrication of riveted and welded pressure vessels, tubular equipment, pemstock piping, bends and forgings.—The Babcock & Wilcox Company, 85 Liberty St., New York, N. Y.

(281) INSULATORS — Catalog 10, 16 pages, Economy "Red Cap" insulators, a handbook of industrial wiring appliances.—Economy Electric Products Company, 4554 Broadway, Chicago, Ill.

(282) ELECTRIC FURNACES — Bulletin 260, 8 pages, "Falcon" continuous electric furnaces for heat treating ferrous and non-ferrous strip metal and wire.—H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa.

(283) WELDED PIPE — Handbook, 40 pages, Armco Spiral Welded Pipe.—The American Rolling Mill Company, Middletown, Ohio.

(284) COMPRESSORS—Bulletin 3132, 44 pages, the complete line of I-R turboblowers and turbo-compressors.—Ingersoll-Rand Company, 11 Broadway, New York, N. Y.

(285) DEEP-WELL PUMPS—Bulletin, 32 pages, line of water-lubricated turbine pumps. Shows adaptation of various types of power drives.—Pomona Pump Company, Pomona, Calif.

(286) LUBRICATION—June, 1931 issue, "Alemite Industrial Lubrication," piped lubricant system at Inland Steel.—Alemite Corporation, 2650 North Crawford Ave., Chicago, Ill.

(287) POWER TRANSMISSION — Form 203, 18 pages, "Preloaded Ball Bearings for Precision Spindles."—SKF Industries, Inc., 40 East 34th St., New York, N. Y.

(288) POWER TRANSMISSION—Booklet, 12 pages, "Gripwell" belt dressing for preventing slippage.—Gripwell Manufacturing Company, 40 East 34th St., New York, N. Y.

(289) FIREBRICK—Bulletin, B. & W. No. 80 insulating firebrick.—The Babcock & Wilcox Company, 85 Liberty St., New York, N. Y.

(290) FOREMAN TRAINING — Weekly bulletins for company foremen directed at the reduction of operation costs and common-sense methods for the foreman-manager's use.—The American Rolling Mill Company, Middletown, Ohio.

(291) FENCE—Booklet, "Why Aluminum Fence," an outline of the development of aluminum and its use for this purpose.—Page Steel & Wire Company, Bridgeport, Conn.

(292) CONTROL EQUIPMENT — General Bulletin G-1, 4 pages, automatic across-the-line switches.—Allen-Bradley Company, Milwaukee, Wis.

(293) CEMENT—Bulletin, B. & W. No. 80 refractory cements and plastics, uses and methods of applications.—The Babcock & Wilcox Company, 85 Liberty St., New York, N. Y.

(294) THERMOMETERS—Bulletin 169, 40 pages, a complete description of the units which compose a modern recording thermometer.—Foxboro Company, Foxboro, Mass.

(295) MAGNETIC CLUTCHES—Booklet, "Keeping Pace with Machine Design," details of construction, operation, and application of C-H magnetic clutches.—Cutler-Hammer, Inc., 294 North 12th St., Milwaukee, Wis.

(296) MATERIALS HANDLING—Booklet 1292, 12 pages, car spotters, dimensions, capacities, and speeds.—H. W. Caldwell & Son Company, 2410 West 18th St., Chicago, Ill.

(297) CONTROL EQUIPMENT—Bulletins and Price Sheets, new and revised—No. 201, "Direct-Current Contactor"; Bulletin 609, "Hand-Operated Starting Switch"; Bulletin 701, "Alternating-Current Contactor"; Bulletin 705, "Alternating-Current Reversing Switch" Bulletin 709EP, "Explosion-Proof Across-the-Line Switch"; Bulletin 710, "Across-the-Line Starting Switch"; Bulletin 710DT, "Dust-Tight Across-the-Line Switch."—Allen-Bradley Company, Milwaukee, Wis.

COMING EVENTS

American Institute of Electrical Engineers—Annual Pacific Coast Meeting, Lake Tahoe, Calif., Aug. 25 to 28. Secretary, F. L. Hutchinson, 33 West 39th St., New York, N. Y.

American Welding Society—Fall Meeting and Exposition, Boston, Mass., Sept. 21 to 25, Secretary, A. V. Hutchinson, 51 Madison Ave., New York, N. Y.

National Metal Congress and Exposition—Exposition, Commonwealth Pier, and Congress sessions, Hotel Statler, Boston, Mass., Sept. 21 to 26. W. H. Eisenman, Secretary, A.S.S.T., 7016 Euclid Ave., Cleveland, Ohio.

National Safety Council—20th Annual Safety Congress, Chicago, Ill., Oct. 12 to 16. Headquarters, Civic Opera Building, Chicago, Ill.

Illuminating Engineering Society—Annual Convention, Hotel William Penn, Pittsburgh, Pa., Oct. 13 to 16. Assistant Secretary, Frank G. Horton, 29 West 39th St., New York, N. Y.

American Society of Mechanical Engineers—Annual meeting, New York City, Nov. 30 to Dec. 4. Secretary, Calvin W. Rice, 33 West 39th St., New York, N. Y.

MAINTENANCE ENGINEERING'S DATA SHEETS

Recommended Levels of Illumination for Industrial Interiors

Illumination values that are considered desirable for different classes of work are given in the table; values based upon practice established through years of experience. A range of foot-candle values is given for each group of operations. In practice it will usually be found desirable to select values in or even beyond the upper portion of the range. They apply to measurements of the lighting equipment in use, not simply when the lamps and reflectors are new and clean.

	Foot-Candles Recommended
Aisles, stairways, passageways	3- 2
Assembling	
Rough	8- 5
Medium	12- 8
Fine	20-12
Extra fine	100-25
Automobile Manufacturing	
Automatic screw machines	15-10
Assembly line	15-10
Frame assembly	12- 8
Tool making	20-12
Body manufacturing—assembly, finishing and inspecting	100-25
Bakeries	12- 8
Book Binding	
Folding, assembling, pasting, etc.	8- 5
Cutting, punching and stitching	12- 8
Embossing	15-10
Candy making	12- 8
Canning and preserving	12- 8
Chemical Works	
Hand furnaces, boiling tanks, stationary driers, stationary or gravity crystallizing	5- 3
Mechanical furnaces, generators and stills, mechanical driers, evaporators, filtration, mechanical crystallizing, bleaching	6- 4
Tanks for cooking, extractors, percolators, nitrators, electrolytic cells	10- 6
Clay Products and Cements	
Grinding, filter presses, kiln rooms	5- 3
Molding, pressing, cleaning and trimming	8- 5
Enameling	10- 6
Color and glazing	15-10
Cloth Products	
Cutting, inspecting, sewing—	
Light goods	15-10
Dark goods	100-25
Pressing, cloth treating (oil cloth, etc.)—	
Light goods	12- 8
Dark goods	20-12
Coal breaking and washing, screening	5- 3
Construction	
Indoor general	5- 3
Dairy products	12- 8
Electric Manufacturing	
Storage battery, molding of grids, charging room	10- 6
Coil and armature winding, mica working, insulating processes	20-12
Elevator—Freight and passenger	8- 5
Engraving	100-25
Forge shops and welding	10- 6

	Foot-Candles Recommended
Foundries	
Charging floor, tumbling, cleaning, pouring and shaking out	8- 5
Rough molding and core making	10- 6
Fine molding and core making	15-10
Garage—Automobiles	
Storage—Dead	3- 2
Live	8- 5
Repair dept. and washing	15-10
Glass Works	
Mix and furnace rooms, pressing and Lehr, glass blowing machines	10- 6
Grinding, cutting glass to size, silvering	12- 8
Fine grinding, polishing, beveling, inspection, etching and decorating	15-10
Glass cutting (cut glass), inspecting fine	50-15
Glove Manufacturing	
Light goods—	
Cutting, pressing, knitting	12- 8
Sorting, stitching, trimming and inspecting	15-10
Dark goods—	
Cutting, pressing, knitting, sorting, stitching, trimming and inspecting	100-25
Hat Manufacturing	
Dyeing, stiffening, braiding, cleaning and refining—	
Light	10- 6
Dark	15-10
Forming, sizing, pouncing, flanging, finishing, ironing—	
Light	12- 8
Dark	15-10
Sewing—	
Light	15-10
Dark	100-25
Ice Making	
Engine and compressor room	10- 6
Inspecting	
Rough	10- 6
Medium	15-10
Fine	25-15
Extra fine	100-25
Polished surfaces	Usually requires glint reflections from specially located light source
Jewelry and watch manufacturing	100-25
Laundries and dry cleaning	12- 8
Leather Manufacturing	
Vats	5- 3
Cleaning, tanning and stretching	6- 4
Cutting, fleshing and stuffing	10- 6
Finishing and scarfing	15-10

(Continued on the following page)

MAINTENANCE ENGINEERING'S DATA SHEETS

Recommended Levels of Illumination for Industrial Interiors

(Continued from the preceding page)

	Foot-Candles Recommended
Leather Working	
Pressing, winding and glazing—	
Light	12- 8
Dark	15-10
Grading, matching, cutting, scarfing, sewing—	
Light	15-10
Dark	100-25
Locker rooms	6- 4
Machine Shops	
Rough bench and machine work	10- 6
Medium bench and machine work, ordinary automatic machines, rough grinding, medium buffing and polishing	15-10
Fine bench and machine work, fine automatic machines, medium grinding, fine buffing and polishing	20-12
Extra fine bench and machine work, grinding (fine work)	100-25
Meat Packing	
Slaughtering	8- 5
Cleaning, cutting, cooking, grinding, canning, packing	12- 8
Milling—Grain Foods	
Cleaning, grinding and rolling	8- 5
Baking or roasting	12- 8
Flour grading	25-15
Offices	
Private and general—	
Close work	15-10
No close work	10- 8
Distribution of mail in post-offices	15-10
Drafting room	25-15
Packing	
Crating	6- 4
Boxing	10- 6
Paint manufacturing	10- 6
Paint Shops	
Dipping, spraying, firing	8- 5
Rubbing, ordinary hand painting and finishing	12- 8
Fine hand painting and finishing	15-10
Extra fine hand painting and finishing (automobile bodies, piano cases, etc.)	100-25
Paper Box Manufacturing	
Light	10- 6
Dark	12- 8
Storage of stock	5- 3
Paper Manufacturing	
Beaters, machine, grinding	6- 4
Calendering	10- 6
Finishing, cutting and trimming	12- 8
Plating	8- 5
Polishing and burnishing	12- 8
Power Plants, Engine Room, Boilers	
Boilers, coal and ash handling, storage battery rooms	5- 3
Auxiliary equipment, oil switches and transformers	8- 5
Switchboard, engines, generators, blowers, compressors	10- 6
Printing Industries	
Matrixing and casting, miscellaneous machines, presses	12- 8
Proofreading, lithographing, electrotyping	15-10
Linotype, monotype, typesetting, imposing stone, engraving	100-25
Receiving and shipping	6- 4
Rubber Manufacturing	
Calenders, compounding mills, fabric preparation, stock cutting, tubing machines, solid tire operations, mechanical goods, building, vulcanizing	12- 8
Bead building, pneumatic tire building and finishing, inner tube operation, mechanical goods trimming, treading	15-10
Sheet Metal Works	
Miscellaneous machines, ordinary bench work	12- 8
Punches, presses, shears, stamps, welders, spinning, fine bench work	15-10
Tin plate inspection	*25-15

	Foot-Candles Recommended
Shoe Manufacturing	
Hand turning, miscellaneous bench and machine work	12- 8
Inspecting and sorting raw material, cutting, lasting and welting (light)	15-10
Inspecting and sorting raw material, cutting, stitching (dark)	100-25
Soap Manufacturing	
Kettle houses, cutting, soap chip and powder	8- 5
Stamping, wrapping and packing, filling and packing soap powder	10- 6
Steel and Iron Mills, Bar, Sheet and Wire Products	
Soaking pits and reheating furnaces	3- 2
Charging and casting floors	6- 4
Muck and heavy rolling, shearing (rough by gage) pickling and cleaning	8- 5
Plate inspection, chipping	25-15
Automatic machines, red, light and cold rolling, wire drawing, shearing (fine by line)	12- 8
Stone Crushing and Screening	
Belt conveyor tubes, main line shafting, spaces, chute rooms, inside of bins	3- 2
Primary breaker room, auxiliary breakers under bins	5- 3
Screen rooms	8- 5
Store and Stock Rooms	
Rough bulky material	3- 2
Medium or fine material requiring care	8- 5
Structural steel fabrication	10- 6
Sugar grading	25-15
Testing	
Rough	8- 5
Fine	15-10
Extra fine instruments, scales, etc	100-25
Textile Mills	
(Cotton)—	
Opening and lapping, carding, drawing-frame, roving, dyeing	8- 5
Spooling, spinning, drawing-in, warping, weaving, quilling, inspecting, knitting, slashing (over beam end)	12- 8
(Silk)—	
Winding, throwing, dyeing	12- 8
Quilling, warping, weaving and finishing—	
Light goods	15-10
Dark goods	20-15
(Woolen)—	
Carding, picking, washing and combing	6- 4
Twisting and dyeing	10- 6
Drawing-in, warping—	
Light goods	10- 6
Dark goods	15-10
Weaving—	
Light goods	12- 8
Dark goods	20-12
Knitting machines	15-10
Tobacco Products	
Drying, stripping, general	3- 2
Grading and sorting	25-15
Toilet and wash rooms	6- 4
Upholstering	
Automobile, coach and furniture	15-10
Warehouse	3- 2
Woodworking	
Rough sawing and bench work	8- 5
Sizing, planing, rough sanding, medium machine and bench work, gluing, veneering, cooperage	12- 8
Fine bench and machine working, fine sanding and finish	15-10

Where the higher levels are specified for particular processes, such illumination need not be supplied in all parts of the room, nor on all parts of a machine, but only where work of the type indicated is likely to be performed.

*(*Special glint lighting recommended)*

American Standards Association, 1930